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Vol. 5 No. 55/56 (New Series) JULY-AUGUST, 1959

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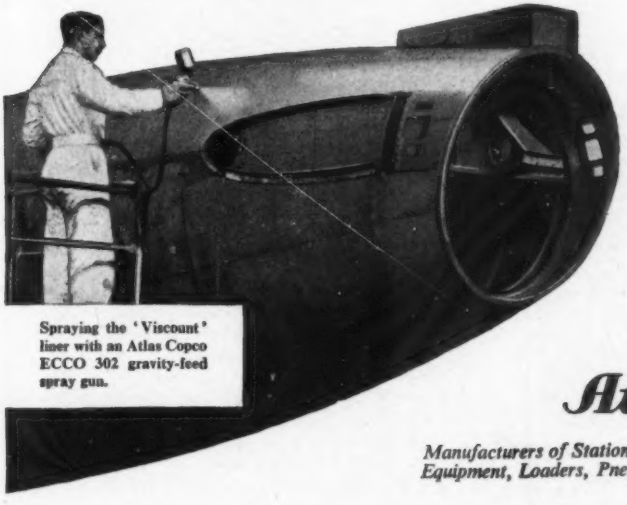

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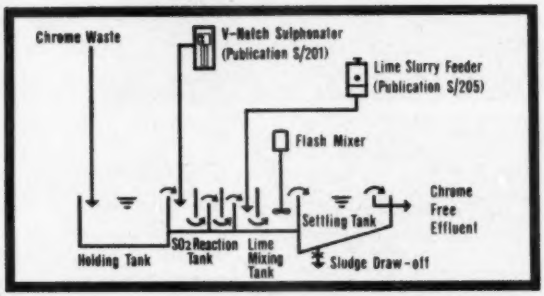

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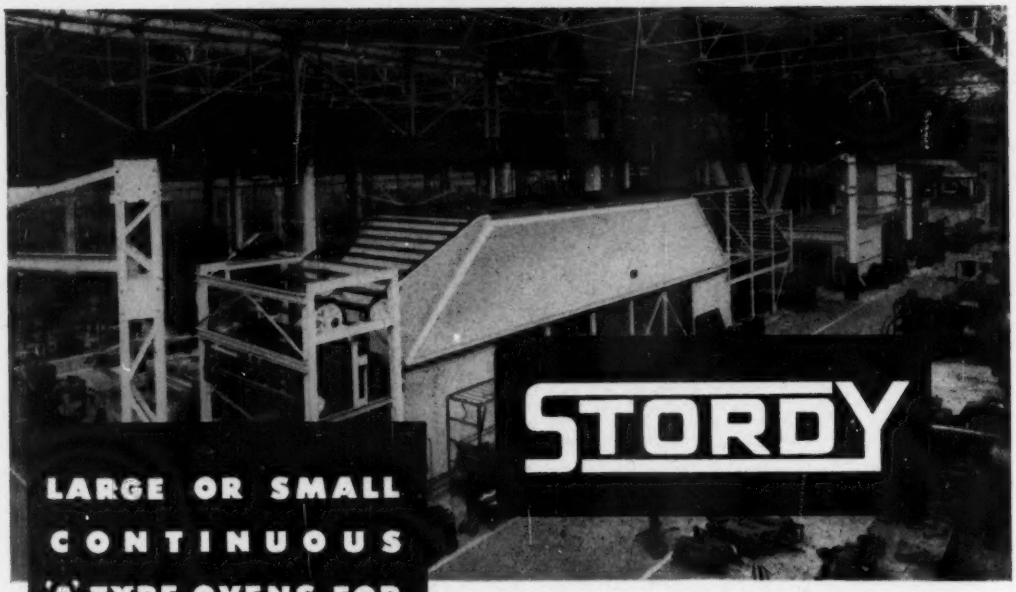

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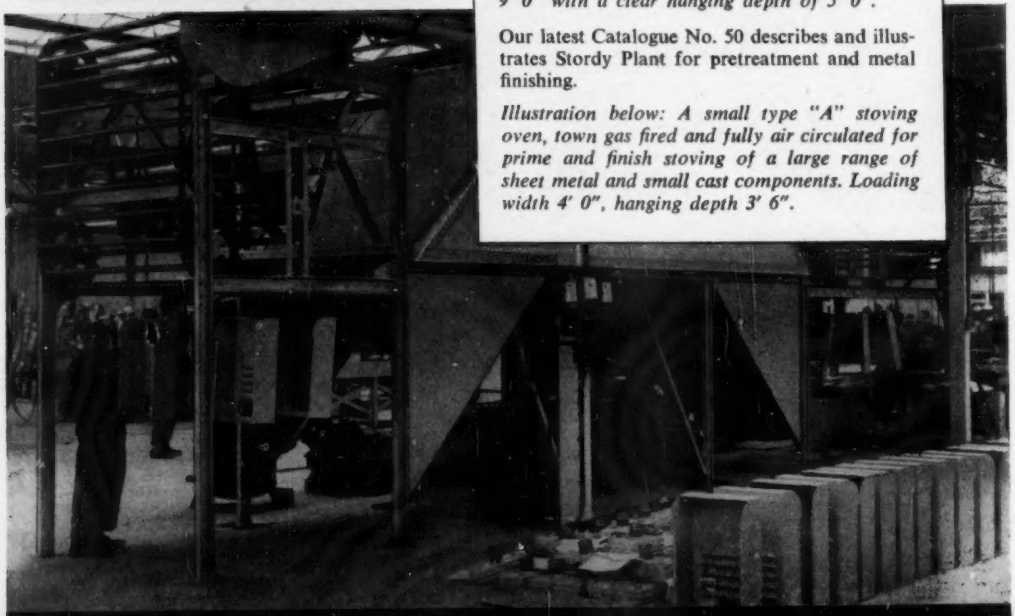
Illustration below: A small type "A" stoving oven, town gas fired and fully air circulated for prime and finish stoving of a large range of sheet metal and small cast components. Loading width 4' 0", hanging depth 3' 6".



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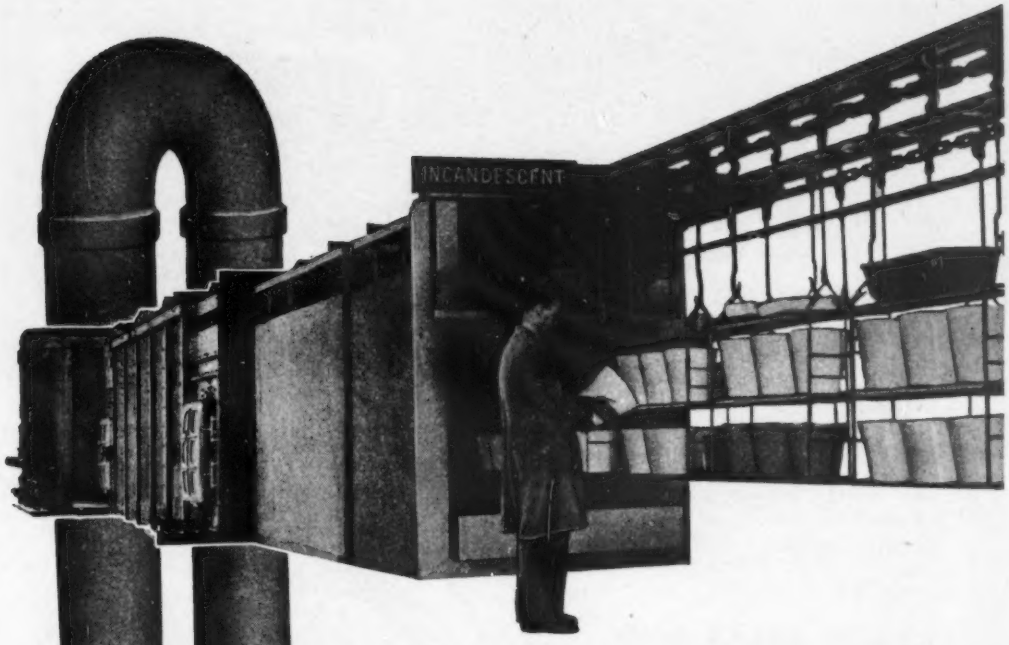

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10/14/59

metal finishing Journal

July/August, 1959 Vol. 5, No. 55/56 (New Series)

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

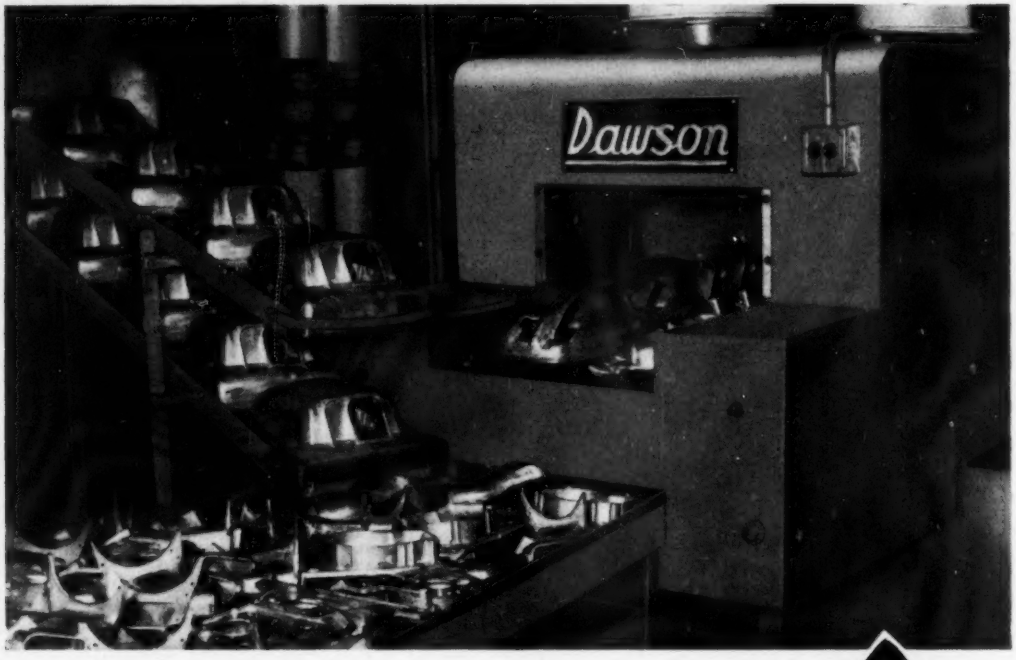
Contents

We regret that owing to the recent dispute in the printing industry it was not possible to publish the July issue of METAL FINISHING JOURNAL on its due date, and it now appears as a combined issue with that for August.

This combination of the two issues will enable us to make the most speedy return to our normal practice of publishing on the 15th of the month, with our September issue.

Current subscriptions will be extended for one month so that subscribers will receive their normal quota of 12 separate issues.

Cleaning component parts for the new Hoover Junior Cleaner



At the highly mechanised Hoover Factory at Perivale in Middlesex a Dawson metal cleaning and degreasing machine plays an important role in the efficient production line for the new Hoover Junior cleaner. The illustration above shows how the three diecast components converge ready for washing. The two smaller components come from the bottom left and the housing comes down the chute from the top left.

This is only one of the countless applications for the Dawson metal cleaning and de-greasing machines which are widely used in every grade of engineering from electric shaver components to heavy diesel cylinder blocks.

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HAVE YOU BEEN AWAY?

WHAT a wonderful Summer this is! Hours of uninterrupted sunshine, temperatures soaring to the eighties, miles-long queues of holiday cars, plated bumper to plated bumper, heading for the distant coast line and carrying Britain's millions away from their work-a-day worries to long carefree idylls by a golden strand. Over, alas, all too soon and back to the daily round with a mahogany tan (or a blistered back) as ephemeral souvenirs of the idle hours, to be met by one's colleagues with the off-hand greeting "Oh, have you been away?—We hadn't noticed." What a cruel and manifestly untrue exaggeration this must be. How could it have passed unnoticed—the absence of that assured and decisive mind—the crisp and confident decision—the daily competent grapple with the multitude of problems brought in with the morning's mail? Surely the wheels of industry must have faltered and lost their rhythmic pulse while one of their most essential driving cogs was sunning himself far from his desk; but perhaps the only person who is really missed when he fails to put in an appearance is the boy who makes the tea.

METAL FINISHING JOURNAL has been absent too; not on a voluntary vacation, but unavoidably prevented from putting in its usual appearance last month by circumstances entirely outside our control As mere customers of the printing industry we were in no way a party to the dispute, the cost of which, direct and indirect, has been estimated to have run into many tens of millions of pounds, and our hope, now that a settlement appears to have been reached, is for a period of enduring stability in that industry so that we can continue to extend our normal service to the finishing industries.

In the light of our earlier comments it might have been expected that the temporary non-appearance of this Journal would have passed unremarked, whereas on the contrary it has been most gratifying and encouraging to note the extent to which we have been missed. In spite of the acknowledged vital necessity for the maintenance and extension of channels of technical and commercial communication, it would be unrealistic to claim that their temporary and short-term dislocation would have immediate and catastrophic effects on technology and trade. On the other hand there has been no lack of evidence during the seven-week stoppage, that the hiatus in publication made itself felt more rapidly than might have been expected, and this at a time of the year when the tide of technical activity is normally at its lowest ebb.

In disseminating information to any industry, as for example to the metal-finishing industries, the task is twofold. There is the need to provide a medium for the publication and discussion of matters relating to scientific and technological developments and it is also necessary to maintain an information service relating to the whole field of the industry, against the background of which information industrial administrative policy is formulated. Much of such news and information is of a transitory nature and, with the passage of time ceases to be topical or even pertinent.

On resuming normal publication we have been faced with the need to select from the happenings of the past few months those likely to be of more permanent interest so that we can get off to a fresh start in subsequent issues. It's nice to be back.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

GETTING TOGETHER

THE Fifth International Conference on Electrodeposition which took place in Detroit in June was probably the most truly international meeting of its kind held so far. This is due in no small degree to the Institute of Metal Finishing which was responsible for organising the papers originating from the whole of Europe. Also, the contingent of delegates from Europe and from the United Kingdom in particular, must have constituted an all-time record.

One unfortunate aspect of the Conference, however, is that so far as participation by corporate European metal finishing bodies is concerned, the position has not advanced since the last International Conference in London in 1954. No European country, outside Great Britain, has any organisation corresponding to the Institute of Metal Finishing or the American Electroplaters' Society, although when the International Council for Electrodeposition was formed 10 years ago, it was hoped by the British and American Societies that more countries would wish to join in its work. One can speculate on the reasons for this, but it does appear that technical societies do not seem to flourish well outside the English-speaking countries. Germany, for example, with its highly developed electroplating industry still has no technical body representative of the industry although moves appear now to be proceeding to form a German electroplaters' society to be known as " Deutsche Gesellschaft fur Galvanotechnik."

Curiously enough, Germany has a supply houses association of which there is no counterpart here or in the U.S.A. This originated after the war primarily to negotiate on behalf of the industry with the occupying powers, but still seems to be carrying on its work in a number of fields to the mutual benefit of its member firms, and, it is hoped, for their customers.

No doubt in the fullness of time things will change on the Continent, perhaps under the stimulus of the Common Market.

MORE WORK AND FEWER WORKERS

AS the mechanisation of production gathers momentum, its effect on employment is becoming noticeable. Very few firms would actually dismiss employees as a result of automation, even if they were allowed to do so, but natural wastage occurs for one reason or another. The trend has been not to replace labour on the same scale with increasing production.

A striking example of this is seen in the case of the Ford Motor Co. Ltd. Last year the company produced one-third more vehicles than in 1956 with a labour force which was actually slightly smaller. It is evident that this aspect of production will have to be given careful attention on a national scale. Only recently a statement was made in the "Times" that even today, with the motor industry booming, there is enough surplus capacity at Ford, Vauxhall and the British Motor Corporation to cope with the entire output of all the other motor car producers put together !

CORROSIONISM

EVERYBODY knows what is meant by corrosion, but as is so often the case, finding a precise definition of the term is more difficult. There is also little doubt that with the increasing interest in this field, a profession will soon develop and a name will have to be found for those engaged in it. The term " corrosionist " has been suggested but is singularly unattractive and should be dropped before someone starts an Institution of Corrosionists to be engaged, presumably, in corrosionism !

One difficulty is that the corrosion expert studies corrosion and at the same time his work is concerned with anti-corrosion measures to a large extent. Strictly speaking, therefore, he is, if anything, more likely to be an " anti-corrosionist." A further complication is that the study of corrosion brings in the subject of protective coatings and these are very frequently non-metallic, although corrosion itself is usually regarded as referring specifically to metals. This is a field on its own, and it is thus obvious that anyone claiming to have a real knowledge of the subject must be a very versatile individual indeed.

THE UNWILLING PLATERS

"THE pre-war stainless steels Hooper's used were of such a high standard that interior cranks or handles did not have to be plated. Because such steel isn't available now at any price, Hooper's reluctantly plate such parts. They do this plating themselves because no one else can come up to their specifications."—*Lilliput*.

Oh, for the good old days !

Some Investigations into BRIGHT FINISHING IN NICKEL BATHS and the Influence of Impurities

by A. CHAYBANY

DURING investigations on electrolytic cobalt-plating the author found considerable differences between the properties of electrodeposited cobalt and nickel, particularly in regard to external appearance and protecting power. It was especially observed that cobalt-plating baths are more easily adapted to give a bright or gloss finish to the coating than nickel-plating baths of the ordinarily-used compositions, and the author has investigated the reasons for this difference.

His researches and their results have led to the formulation of the following conclusions :

1. It is easily understood that there is only one form of bright-plating with nickel which may be termed a gloss finish. A gloss or bright finish is one which, when withdrawn from the bath, is akin to the finish obtained by mechanical polishing.

On the contrary, matt coatings or dull finishes are present in a number of different, easily distinguishable forms; and each different matt finish is doubtless due to a different cause, the source of which must be determined.

2. The quantity of material actually involved in producing a gloss or bright finish is exceedingly small and cannot be determined analytically with any certainty. This material, probably of a colloidal nature, is continuously precipitated by anodic action and is continuously eliminated, either by deposition on the cathode or by coagulation in the electrolyte and is discharged with the sludge.

On the other hand, the author has observed that minute quantities of " impurities " (contaminating substances) suffice to destroy the gloss or bright surface finish over the whole or a part of the surface of the work-piece. On the other hand, the removal of such " impurities " may impart or restore to the bath the capacity to produce a bright finish or gloss; all other conditions being maintained.

3. The physical and chemical factors contributing to the production of a bright or gloss finish are very numerous; they act on the anodic and cathodic polarisation of the bath, act as stabilisers, or form complexes with the impurities so neutralising their effect, or rendering such impurities insoluble and thus facilitating their elimination or discharge from the bath.

4. The chloride compounds appear to possess gloss-destroying properties. The author has observed that, after having purified the sulphate or chloride salts of nickel to the extent possible with the available chemical methods, and also additives such as boric acid or " conductor salts," he has invariably obtained matt deposits when using bath compositions of the Watt or Thompson type, even when the cathode was enclosed in a porous porcelain pot to prevent it being directly influenced by the nickel anode. Increasing the temperature improved the appearance of the work-pieces, owing to the finer grain of the metal deposited.

Whatever the brightening agent used, it must be present in increasing quantity or heated to an increasingly higher temperature, the greater the number of chlorine anions present in the bath. Everything indicates that the brightening agent inhibits the action of any chlorides present, which are principally introduced to promote solution of the anode. If the brightening agent acts to diminish their efficacy, it would appear unnecessary to use it in large quantities. With little or no chloride in the bath, it has been established that it should be possible to reduce the quantity of brightening agent.

Regular attack and solution of the anodes can be obtained in different ways. A low degree of mineral acidity and the introduction of ammonia salts are well-known devices. The double, nickel-ammonium sulphate in saturated solution has given satisfaction to two generations of nickel-platers. Later the hydroxy-acids were introduced; citric, tartaric, or lactic. Since about thirty years ago, the aryl-sulphonic acids and their derivatives have attained a leading position.

The author himself uses a few grams per litre of an alkaline bromide. In general, up to 5 grams are sufficient for a cold bath and even less if the bath is heated. He has also used iodides in even smaller quantities, without affecting the bath characteristics, anode or cathode yields, rate of precipitation, etc.

There should be an explanation of this behaviour of the chlorides (in fact there may be several explanations) but this is not the place to discuss the matter any further.

The author would like to mention, however, that the cobalt-plating baths which he has studied from the point of view of their gloss or bright-finishing effect, have all been free from halides.

5. The principal extraneous elements which can be most readily studied in nickel-plating baths are cobalt, iron and copper.

Cobalt appears to promote gloss.

Iron in the ferrous state, as a solution of ionized salts, may be carried over in the metallic state and in small quantity into the nickel deposit. In the tervalent state and in simple combination, hydrolysis takes place and the ferric hydrate becomes insoluble, being discharged with the sludge; or it may be carried over in a very small amount into the deposit to which it imparts a matt (dull) finish.

On the other hand, if it enters into complex combination, it may be harmless. The author has added to the bath considerable quantities of ferri-sodium tartrate, without noticing anything wrong, always provided that the iron is present in the ferric state.

Copper acts similarly in both its valency states. It appears to be very harmful in the univalent state. The cuprous halides, not ionized, difficultly soluble in water but much more soluble in the presence of alkaline halides in concentrated solution, may be carried over by electrophoresis into the deposit and make it dull; or they may form on the cathode simultaneously with the deposit, blend with it and render it dull. The two appearances are, however, not identical.

In the first case, when the halides are carried over electro-mechanically, the deposit is " dirty bright " in appearance, improving rapidly during the treatment and finally disappearing.

In the second case of precipitation on the cathode, the deposit is " milky " in appearance, sometimes very difficult to remove by mechanical polishing, particularly in the hollows of the work; the defect is not removed by continuing treatment, or may even become worse.

Quantities of less than one milligram of copper per litre of bath solution may cause such trouble. This figure has been confirmed by the author, both by direct analysis and from the quantity of reagent necessary to restore the bright finish.

In such conditions, the quantity of copper taken up by the deposit must be infinitesimal and quite out of proportion to the observed effect. There would appear to be some form of catalytic action taking place and the chemical mechanism of the phenomenon is not simply a carry-over. Other observations made by the author justify this conclusion.

If, on the contrary, the copper contained in the electrolyte can be maintained in the bivalent form of an ionized salt, it appears to have no effect on the appearance of the deposit; either it precipitates simultaneously with the nickel in the metallic state or it accumulates in the bath whence it can be discharged periodically.

The author will now describe a method of bright-finishing of which he has made a particular study. The whole problem turns on the elimination of the impurities, copper and iron, when the chemical analyst can state with some certitude the presence of either or both of these elements in the electrolyte. Other hypotheses and theories, less justifiable by direct experience, will not be considered.

A few words will also be said on a method of bright-finishing when the copper and iron are present in the form of complexes and thus harmless.

Finally, mention will be made of a process in which iron is eliminated automatically, while the copper is precipitated together with the nickel in the metallic state, forming a true alloy of homogeneous structure and brilliant appearance.

Historical Survey

The first observations date from the war years in Paris and are associated with the necessity for purifying or regenerating nickel-plating baths. The principal contaminant or impurity was copper. The author has handled nickel sulphate from which blue crystals of copper sulphate could be sorted out by hand. Anodes containing up to 8 per cent copper were no rarity and there was no other choice.

Purifying the bath electrolytically is only quick and easy in an acid medium; but the necessity for interrupting processing and the inconvenience of the presence of the lime used for neutralizing in the saturated sulphate solution make this technique of small practical value.

The author has used chemical methods. Copper thiocyanate and iodide have low solubility and the elimination of copper by this means has been the most thoroughly studied. Preference is given to the thiocyanate, as the cheaper reagent.

Thiocyanate acts in the presence of a reducing agent, in the actual case sodium hydrosulphite, in accordance with the following elementary equations. Reduction takes place according to: $6.CuSO_4 + Na_2S_2O_4 + 4.H_2O \rightarrow 3.Cu_2SO_4 + 4.H_2SO_4 + Na_2SO_4$

The cuprous sulphate thus formed gives by double decomposition with ammonium thiocyanate: $Cu_2SO_4 + 2.CNS(NH)_4 \rightarrow 2.CuCNS + (NH_4)_2SO_4$. Cuprous thiocyanate, which is insoluble precipitates.

The ammonium thiocyanate is added in slight

excess, followed by the sodium hydrosulphite, in freshly-prepared solution, until precipitation ceases. The acid freed in the first equation is intended to be neutralised by the ammonia. After standing overnight, the CuCSN is all precipitated and can be filtered off.

The author has frequently observed that if articles are nickel-plated in the resulting clear liquid, a zone formation is apparent, of perfectly bright zones side by side with dull bands or even blackening at the bottom of hollows. If it were possible to eliminate the last-named, the problem of bright-finishing would be solved.

In the meantime, the author has resorted to neutralizing the excess of reagents with potassium permanganate, added until a persisting colouration is obtained, after 24 hours standing. A few drops of hydrogen peroxide cause this coloration to disappear—an excess should be avoided, which would cause renewed dissolution of the magnanese dioxide. The filtered liquid then acts normally, giving matt deposits.

The author has likewise observed that an addition of ammonium thiocyanate to the liquid then no longer produced an alternation of bright and dull (matt) bands. Some other element than an excess of reagents has therefore been eliminated by the potassium-permanganate treatment. Analysis of the sludge from this process has disclosed traces of cobalt and it is possible that this latter element has also been involved.

This investigation was followed by a laboratory research the details of which it is not necessary to mention.

Bath Composition

The author confesses to having no personal preference for any particular bath formula. The principal bath constituent can only be nickel sulphate of industrial quality. The additive agents, " conductor salts " and the like seem to improve the electrical conductivity of the bath, but the true manner in which they act remains obscure.

The author has developed the following, limiting composition :

7 H_2O nickel sulphate	120/300	gm. per litre
Ammonium sulphate	20	„ „ „
Anhydrous sodium sulphate	100	„ „ „
Potassium bromide	1/5	„ „ „
Boric acid if desired	20/40	„ „ „

Whatever the degree of purity of the substances used, the resulting deposit obtained with this bath will be dull or matt. When obtained, however, the bright finish is permanent, and easily maintained. The operation also includes removal of the " impurities." This is the point on which stress is laid here.

Bright Finishing

The starting electrolyte is made up as follows (cold) :

Nickel sulphate	120 gm.
Ammonium sulphate	20 gm.
Potassium bromide	5 gm.
Water to make up to 1 litre	
If to this liquid there is added	
Potassium thiocyanate	50/100 mg.

and electrolysis conducted in a cold bath with a current density of about 1 amp. per sq. decimetre, using a polished brass cathode surface corresponding to the anode, no gas discharge at the anode would be noticeable.

After about one hour the precipitated deposit shows, depending on the shape of the cathode, a number of zones or bands of different appearance, the trend being in the direction of decreasing current density :

A " burnt " band
A very bright band
A very dull band
A very bright band
Blackening in the hollows.

The " burnt " region is well-known and disappears with decreasing current density. It is due to some hitherto insufficiently identified phenomenon. In regard to the third, dull band, the author is of the opinion that it is due to the presence in the electrolyte of tervalent elements which may have already existed previously, or may have been formed during the electrolysis. This band is made to disappear by the addition of reducing agents.

The blackening in the hollows is very probably due to the presence of copper and disappears when this is eliminated.

The entire process develops as if the small quantity of added thiocyanate by its polarizing action on the anode and the disturbance of the equilibrium of the bath, causes the nickel deposit to separate from the precipitated impurities.

An addition of sodium hydro-sulphite, up to 50 mg. per litre allows the dull bands to be suppressed, by its reducing action on the tervalent elements and by elimination of the copper. If a further 100 gm. of anhydrous sodium sulphate are added to the bath, the change in the appearance of the deposit is remarkable; it becomes uniformly " dirty bright " but a few more hours of treatment, during which the sulphocyanide or sulphide of copper are eliminated by being carried down, in a state of supersaturation or colloidal suspension, restore the bright finish of the deposit to any desired degree. Continuous filtration and raising the temperature to 30 to 35° accelerate the process.

The bath is now formed; 20 gm. or more of boric acid may be added if desired.

The active element in this case appears to be the *cobalt;* although the author must confess to being unable to furnish any direct proof of this. The quantity of substance involved, probably of a colloidal nature, is very small, and the tests can only be indirect.

The reason for assuming the colloidal nature of this substance is the slow rate of its formation and its behaviour towards physical and chemical agencies. The author is of the opinion that it must be present in the matt or dull baths: he has, in fact, noted that after working for a few months, when a state of equilibrium has been produced between the anodes and the electrolyte, as will be observed on the uniform appearance of the nickel deposits, the baths are easier to revivify to a bright character than baths of younger date.

While, at the beginning the electrolyte may be quite free from cobalt, an appreciable quantity will become liberated from the anode within a short space of time. At the same time, the bath liquid becomes turbid, due to the iron passing simultaneously into solution.

The quantity of hydrosulphite to be used, as indicated above, is in excess of that needed to eliminate the copper. The reduction obtained with this reagent proceeds in two stages. The first reaction is practically instantaneous, the second stage develops more slowly. It is possible to imagine the presence of a salt of the sesquioxide in the solution, which is rapidly reducible, and of a colloidal, tervalent hydroxide, on which the reagent acts more slowly. The author has noticed that after several weeks at rest, the bath loses its brightening power; the reducing agent is in this case the thiocyanate itself, which ultimately breaks down the colloidal substance.

It may be mentioned that the existence of colloidal nickel peroxides has already been reported, in reports of work on the chemistry of minerals. When cobalt and nickel are present simultaneously, however, the first, being more readily oxidized, forms its peroxide more quickly. For certainty of eliminating contamination, the anodes used should be scrupulously free from cobalt; otherwise, some uncertainty must remain.

Iron is ordinarily eliminated in the form of the hydroxide, carrying over with it a little nickel. Since the liquid tends to become alkaline, elimination proceeds regularly and this element does not accumulate.

Copper is the impurity to which the electrolyte is the most sensitive. The method described enables elimination in the form of the cuprous thiocyanate, if the concentration is over 4 to 5 mg., metal basis, per litre. For smaller quantities, supersaturation takes place and the salt is not precipitated; the element ultimately precipitates and is removed as the sulphide.

Dull patches are formed in the hollows of the work by quantities of copper present in the electrolyte which are so small that no purely chemical method available to the author has enabled their quantitative determination: every possible method of purifying nickel salts which was available has also been tried in determining the formation of these spots.

As has already been said, the quantity of copper present in the electrolyte or carried over into the deposit is out of proportion to the effect produced. The phenomenon of spottiness appears to be associated with the presence of a " black " form of nickel, the investigation of which does not appear to have been regarded as sufficiently important for consideration by our theoreticians in the field of applied science.

The *thiocyanate ion* is the only one which is both formed and destroyed in the normal working of the bath. Undoubtedly, it plays a number of parts. It has also been used for the elimination of copper. Its presence maintains the copper in a state of insolubility, causing it to be held back in the anode mud.

Further, the alkaline thiocyanate, a mild reducing agent, exerts a depolarizing action on the anodes and prevents the tervalent elements from accumulating. In practice. the addition of this salt enables the region of " burning " to be reduced and allows a higher current intensity to be used. With a well-balanced bath, and a properly-controlled anode surface, it is possible to work at low temperatures with current densities exceeding 2 amp. per sq. decimetre.

Elimination by anodic oxidation is very slow. The author estimates it at 1 to 3 mg. per amp. hour over a year's working; 100 to 200 mg. of the free reagent are sufficient and there does not appear to be any good reason for exceeding this figure.

Complete elimination is indicated by the appearance of dull spots in the hollows: copper has become dissolved or is in course of dissolution. Add 50 to 100 mg. potassium thiocyanate and 10 to 15 mg. hydrosulphate; increase the area of the anode surface.

Other thiocyanates than the potassium compound have been tried by the author, in particular, the thiocyanates of ammonium, cobalt and nickel. Certain differences in behaviour have been observed at starting; but molecular movement finally finishes by linking the anions with the cations and the equilibrium state is the same, whatever the starting substances used.

Sodium hydrosulphite is the depolarizer preferred by the author. Other mineral reducing agents,

such as hydrazine sulphate or hydroxylamine have also been tried; but only the hydrosulphite allows the elimination of traces of copper as the sulphide.

An excess is to be avoided as leading to the formation of colloidal, black nickel sulphide. The colour of the liquid darkens, and the deposit is greyish, another form of dulling. After several hours of working, however, the deposit again brightens.

Potassium bromide is added when starting the bath cold; addition is continued until no more gas bubbles are released from the anode, with a characteristic odour of bromine.

"*Conductor Salts.*" In practice, the action of these salts is most pronounced in a cold bath.

The addition of sulphate of ammonia to the electrolyte enables a far higher current density to be used. The author has frequently observed that the black spots on projecting parts, or spottiness generally, can be made to disappear, either by adding this salt or by raising the bath temperature.

On the other hand, thickness tests have shown the author that in the presence of sodium sulphate the coating is more regular in a cold bath, and porosity in the hollows is less. The addition of this salt frequently enables black or dull spots to be eliminated in these parts, where the current density is lower.

The elimination of iron also seems to be promoted in the presence of this salt. The action of strong acid and alkaline salts in coagulating and precipitating colloids is of course well-known.

The author has analysed the slimes forming in the electrolyte and discharged by filtration—excluding anodic slimes, since the anodes are jacketed. Such slimes consist principally of ferric hydroxide with carried-over nickel hydroxide, in greater or lesser quantities.

It has been observed that in the presence of sodium sulphate the composition of the sulphate approaches:

$$Fe_2O_3.FeO.nH_2O \longrightarrow Fe_3O_4.nH_2O,$$

which is the compound (ferrosoferric) oxide. In the absence of sodium sulphate, the composition is more nearly:

$$Fe_2O_3.NiO.nH_2O,$$

wherein the iron is practically all tervalent. Since oxidation is due to atmosoheric oxygen, it can be concluded that in the presence of sodium sulphate the impurity remains for a shorter time in the electrolyte and does not have time to become completely oxidised therein.

A similar argument would seem to be applicable to the cobalt hydrosal. This substance is formed by an anodizing phenomenon. It develops by progressive enlargement of the particles, which are coagulated and eliminated by the sodium sulphate and carried over with the slimes. This salt is consequently a stabilizer, and controls the colloidal state by preventing the accumulation of large particles which, as is generally known, are extremely harmful.

Other explanations offered of the part played by the alkaline salts, while plausible, are more difficult to define precisely. The problem merits deeper study, extending over the whole realm of electro-plastics.

The bath container may be of bare wood, if the bath is worked cold, or lead-lined if heating is used. The author has calculated the bath capacity in such a manner that about 1:1000 of the metallic nickel present in the electrolyte is renewed every hour, deposited on the work, and returned to the bath through the anodes.

The principal advantage of the bright finishing bath discussed here is the ease of eliminating the additive agent(s). Simple treatment with permangates is sufficient to maintain the bath dull.

The *p*H value does not change appreciably. It remains around 6 for a long time. Any small fluctuations do not materially disturb the state of equilibrium.

Iron and Copper Complexes

The author has found that in some types of dull or matt baths, copper may accumulate in considerable quantities, up to 20 mg. per litre. Its presence becomes suddenly manifested without apparent reason by the appearance of spots of a powdery, black substance which rapidly spread over the whole of the work piece.

This phenomenon has been investigated, and it has been thought that it may be associated with the presence of iron in the electrolyte. Since this element is tervalent, the copper can only co-exist in the divalent state. The cuprous ion, if formed, will become oxidised:

$$Cu^{+} + Fe^{+++} \longrightarrow Cu^{++} + Fe^{++}$$

and the iron, becoming ferrous, reoxidises in air.

In the presence of a sufficient quantity of iron, the copper may thus accumulate in appreciable quantity. If, for some unforeseen reason, *e.g.* heating of the liquid, changes on the anode, higher *p*H value, the iron rapidly becomes insoluble, the copper itself is reduced at the cathode, and produces the above-mentioned black deposit.

Analysis of this substance has shown that it consists of practically pure nickel. The copper, consequently, only acts by catalysis. If it is to be eliminated by electrolysis, the bath should be made highly acid, which will prevent too much nickel being carried over.

For an electrolyte containing iron and copper to be able to function with sufficient stability, these elements must be present in the form of complexes. The oldest and best-known, and most used complex-forming agent is citric acid.

When a small quantity of this acid or one of its salts is added to a dull bath, this latter becomes increasingly bright. The bath appears to be neutral. If the presence of some constituent, such as a salt of sodium, ammonium or magnesium appears to accelerate or retard brightening, as soon as that has taken place, the composition may be varied without any apparent effect. Such baths can function at a low rating and for many years without becoming appreciably spent.

At a very high *p*H value, 6.5 to 7, iron and copper accumulate; but, since the bath tends to become more highly acid, the free acidity is manifested in the form of stains.

At a low *p*H value, towards 4 to 4.5, the complex is destroyed, and the iron is eliminated in the sludge, while the copper deposits together with the nickel.

The author has the impression that very many modern brightening agents are of this type. These baths work at a low *p*H, and only the iron can accumulate appreciably.

The author has tried to modify the brightening action of some baths already in service, of which the true origin, and the composition of the contained, organic brightening agents was unknown. He has frequently been successful. The following is the modus operandi :

The bath is made alkaline with ammonia up to *p*H 6. The iron hydroxide becomes insoluble but this develops very slowly. Sodium and ammonium salts are added to accelerate the process.

The sludge is eliminated by continuous filtration. Throughout this period, the nickel deposit remains bright or only slightly clouded. A few milligrams of potassium thiocyanate are added. The cloudiness disappears but matt patches appear in the hollows. After several hours in the bath, these disappear spontaneously; otherwise, a few milligrams of hydrosulphite disperse them instantaneously.

Such baths can continue to function without any further addition of organic brightener.

Nickel-Copper Alloys

According to the laws of co-precipitation of elements, the deposition voltage for the copper must be increased to ensure its correct precipitation together with the nickel.

This can be obtained by causing it to form an appropriate complex. The author has experimented with ammoniacal, alkaline media, but the deposits obtained are dull and their investigation has no place here.

On the contrary, if the ammonia is replaced by organic amines, the resulting deposits can be bright. Ethylene-diamine falls in this category, and the author has made a particular study of its action.

Commercial ethylene-diamine, NH_2-CH_2-CH_2-NH_2, containing one molecule of water of hydration, is liquid at ordinary temperatures. The melting point is 10°C. the boiling point 118°C. The commercial product is not very expensive.

The base can be neutralized, molecule for molecule, by sulphuric acid, giving the neutral sulphate, which crystallizes easily. The salt combines with one molecule of nickel sulphate to give the double, salt, for which an analysis made by the author gives the following structural formula:

$NiSO_4,H_2SO_4\ (NH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2),\ 6H_2O$

resembling the double sulphate of nickel and ammonium.

The two salts have many points of resemblance, in particular, their stability. The only difference of practical importance is that the ethylene-diamine salt is very readily soluble in water. The cold, saturated solution contains nearly 400 gm., one gram-molecule, per litre.

The following electrolyte :

Double sulphate	200 gm. per litre
Ethylene-diamine sulphate	75 gm. per litre
Potassium bromide	variable

with or without an additive produces bright coatings, both in a cold and hot bath.

If 0.5 to 1.0 gm. sulphate of copper is added, and the bath alkalized with the free base until only the copper forms a complex—which can be recognized by the colour of the liquid turning a faintly violet blue, bright deposits are obtained in a hot bath, homogeneous and more or less high in copper, according to the temperature used.

Such alloys may not be of any practical interest, but their investigation enables our knowledge to be increased of the influence of the presence of copper in nickel-plating baths.

This problem merits extensive development researches.

Summary and Conclusions

The author describes a method of brightening nickel-plating baths.

One of the principal features of this method is the absence of chlorides in the bath.

The author adds in conclusion that his researches on the protective power of nickel coatings on steel have similarly led him to the conception of electrolytes free from chlorides.

FOURTH BAEKELAND MEMORIAL LECTURE

Professor H. Mark, Director of the Polymer Research Institute of the Polytechnic Institute of Brooklyn, New York, will deliver the 4th Baekeland Memorial Lecture of the Society of Chemical Industry under the title "Recent Progress in Polymer Chemistry." The Lecture will be delivered on Thursday October 22, 1959 at 6.30 p.m. in the lecture theatre of the Royal Institution, Albemarle Street, London, W.1.

The PRODUCTION of ANODIC FINISHES in AUTOMATIC PLANTS

By A. W. BRACE, A.I.M., C.G.I.A.*

(*A paper presented at the Annual Conference of the Institute of Sheet Metal Engineering, London, November 5 and 6, 1958*)

SYNOPSIS

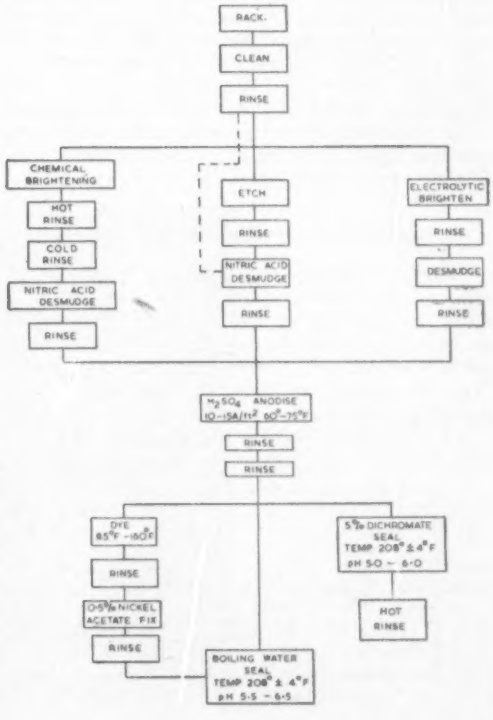
A wide range of finishes is possible by choice of a suitable combination of processes associated with the production of an anodic oxide coating on aluminium The various processes are discussed in relation to their applicability to automatic plants. Experiences with existing automatic plants for producing anodized finishes are reviewed and some of the problems associated with the production of these finishes in such plants are discussed.

Introduction

ONE of the interesting characteristics of aluminium is its ability to take a wide range of finishes. Apart from the usual range of chemical, electroplated and organic finishes, and the recently developed vitreous-enamel coatings, there is one group of finishes which remains uniquely associated with aluminium, namely those in which anodizing is an essential stage. The use of anodizing in mass-production industries, such as those concerned with the production of washing machines, refrigerators, electric-light fittings, motor-car trim, etc., has made it inevitable that attention should be given to producing anodic finishes in automatic plants. Indeed a number of plants are already in existence in various countries.

However, the production of such finishes in automatic plants while solving some problems introduces a number of new difficulties, and it seems appropriate at the current stage of development to review the progress made. One of the main advantages of an automatic plant is that owing to the elimination of the human element in operations involving a series of treatments in various baths, the final product should theoretically be more uniform and of better quality. Achievement of anything approaching the ideal introduces new problems. For example, the quantity of work which may be processed in an automatic plant is so great that some arrangement is necessary for continuous replenishment of solutions. Further, most solutions used for treatment of aluminium are either very strongly acid or strongly alkaline. Often they give their best results within a relatively limited range of temperature and concentration. Often uneven draining and unequal cooling during the time required to transfer the work from the treatment tank to the rinse tank can mar the

Fig. 1.—Processes involved in the production of anodic finishes.



*Chemistry Division, Aluminium Laboratories Limited, Banbury.

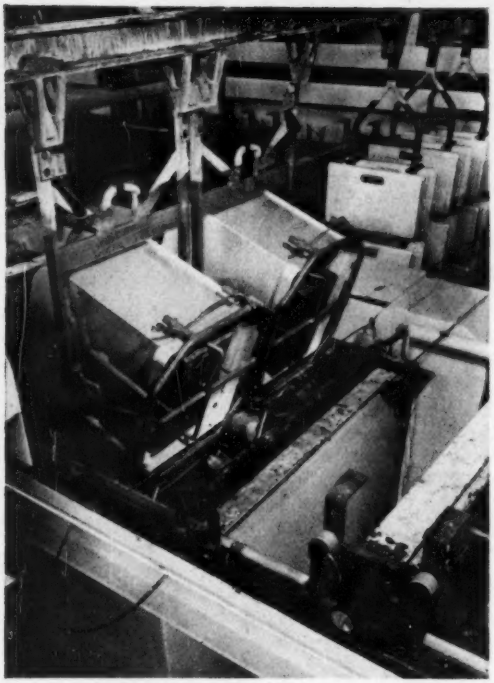


Fig. 2.—View of tubs and lids being transferred from anodizing tank to rinse tank at Hoover (Washing Machines) Ltd. (Courtesy of Product Finishing)

appearance of the finished article. To consider these problems it is necessary to outline the detailed stages involved in production of anodic finishes.

Anodizing and Related Processes

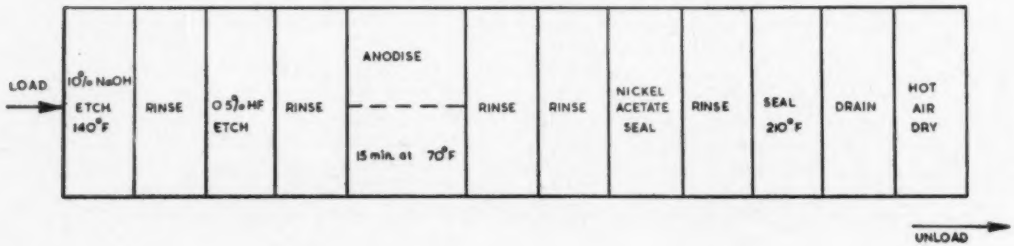
The appearance of the finished article depends upon the processes used before and after anodizing since the function of the anodic coating is to preserve the texture developed prior to anodizing, and to provide a base for dyeing if colour is required. Thus by etching or brightening (or both) before anodizing a particular texture can be achieved which is largely retained on anodizing. If this is to be used in conjunction with a colour then dyeing will follow anodizing. Normally the textures required are either matt or bright—the so-called natural finish is often aluminium given a very mild etching treatment, but experience shows that unless some etching of the surface occurs the subsequent appearance may not be uniform.

An outline of the processing sequence which is required for production of such finishes is given in Fig. 1. An essential feature in the process is cleaning. The nature of the surface contamination naturally influences the cleaning procedures to be adopted : subsequent treatments intended to influence texture such as matt etching or brightening also have to be taken into account. The first treatment will usually be in an inhibited alkaline cleaner which will remove most superficial grease. Aluminium readily forms metallic soaps with the constituents of many drawing lubricants and the presence of these on the surface may interfere with subsequent operations such as dyeing. A mild etching cleaner is essential for the removal of such films. The inclusion of other cleaners such as an emulsion cleaner in the system will depend on the character of the soil to be removed.

When such alkaline cleaners are used, the addition of a nitric-acid desmudge is necessary. If brightening treatments are included in the sequence a desmudge will be a normal processing operation. A factor to be taken into account in the operation of phosphoric-acid brighteners is that carry-over of water into them may adversely affect the results obtained. The introduction of a quick hot rinse or a short drain period prior to brightening helps to minimize difficulties from this source. The practice used by some jobbing anodizers of leaving the brightener to remove surface dirt can be expensive in phosphoric acid and accumulation of such dirt on the surface can mar the appearance of the finished work.

Close control of anodizing conditions appreciably facilitates colour matching where colour-anodized finishes are required. In fact, one of the main advantages of automatic plants is the greater control possible over colour. At present, difficulties with

Fig. 3.—Layout of Hoover automatic anodizing plant.



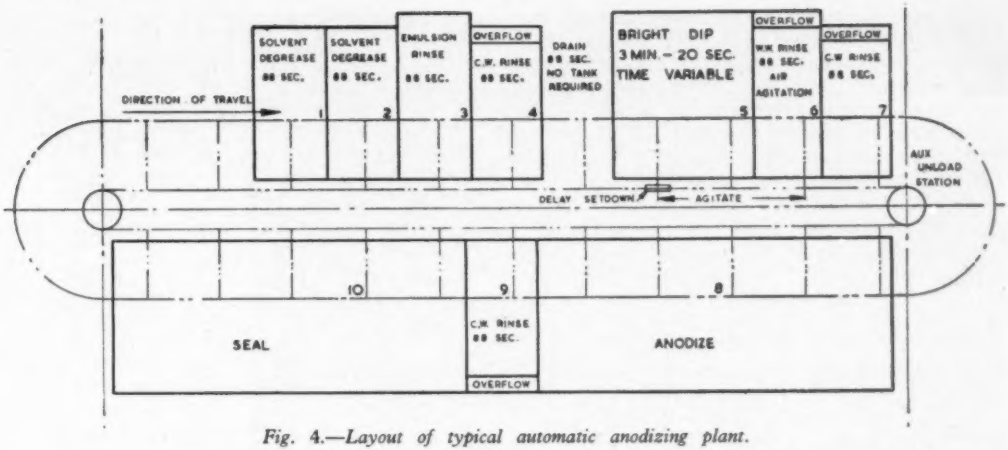


Fig. 4.—Layout of typical automatic anodizing plant.

colour matching on batch anodizing operations have discouraged their adoption on a wide scale. Where production quantities justify an automatic plant there should no longer be a problem in this connection.

Some Existing Installations

The first automatic anodizing plant appears to be that installed for Hoover (Washing Machines) Ltd. Merthyr Tydfil[1] for anodizing of washing-machine tubs and lids. (Fig. 2). The general process sequence is that shown in Fig. 3. Operating experience has shown that nickel acetate fixing is an unnecessary stage in the post treatment of the anodic film. It has now been converted to a hot-water seal. The machine has given satisfactory performance except for a few minor corrosion problems. One particularly interesting feature is the use of a special jig which automatically tips the electrolyte inside the tubs back into the tank prior to transfer to the rinse.

As is almost inevitable with such an installation a point has been reached where the equipment is now being required to undertake work for which it was not intended. The new "Hoovermatic" washing machine has parts which are bright anodized, also bright anodized and blue dyed. *e.g.* the lid. The brightening is carried out after the initial etching in the alkaline cleaner and nitric-hydrofluoric dip by manual removal of racks from one line which are hand dipped into the phosphoric-acid chemical brightener and then anodized. Following rinsing after anodizing the same racks are again hand dipped into a blue dye solution prior to continuing on the conveyor line for sealing.

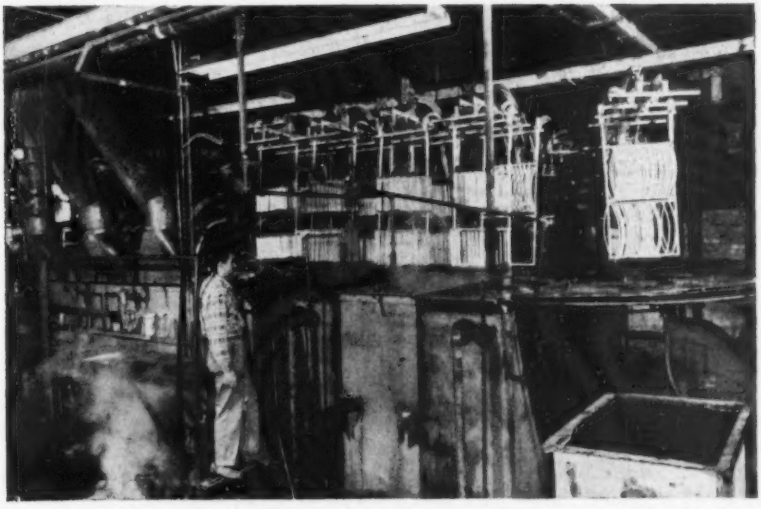


Fig. 5.—Part of automatic plant installed at Light Metal Processors Inc. showing work being removed from dye tanks
(Courtesy of Product Finishing)

One of the minor difficulties encountered was a tendency for grease from the overhead chain drive to fall on to the caustic bath where it formed an unsaponifiable scum. This can be overcome either by using a better grease or by modifying the composition of the cleaning bath. This can be conveniently achieved by the addition of 0.25 per cent of a non-toxic wetting agent such as those containing a polyethylene glycol chain which are soluble in alkalis.

Several automatic plants are in operation in the United States. The lay-out of a typical plant[2] for producing bright anodized refrigerator parts is shown in Fig. 4. On some installations, such as that operating at Light Metal Processors Inc.[3] there is provision for a dyeing stage to be introduced after anodizing. Fig. 5 shows the second rinse tank after anodizing, the dye tank and further rinse prior to final seal. A feature of such plants is that certain operations, *e.g.* brightening or dyeing, can be omitted by a simple adjustment of the controls thus giving greater flexibility to the plant.

The installation at Light Metal Processors Inc. is particularly interesting since this company is essentially a jobbing anodizing company. The anodizing tank is 17½ ft. long x 5½ ft. wide x 5 ft. deep with a 15 per cent (W/V) H_2SO_4 electrolyte thermostatically controlled at 72° F. The length of anodizing and sealing time can be controlled by setting the timing gear to any given number of units of 3½-minute treatments to a maximum of 28 minutes for the combined operations of anodizing and sealing.

Further variants on this general scheme are possible, as shown by the diagrammatic layout of the plant installed at Firestone Steel Products Co. U.S.A. (Fig. 6). This plant[4] employs a sequence which would be particularly suitable for phosphoric chemical brighteners such as Phosbrite 150 and 159. Provision is made for stages to be cut out so that the caustic etch can be omitted for work to be bright dipped and vice-versa. The purpose of the second dyebath is two-fold. Much of the work for which the plant was designed involved the production of a gold dyed finish for which a ferric-ammonium-oxalate dip was specified. Because the gold colour so produced was too yellow, a short dyeing treatment in a red dye was added.

The provision of a second dyebath also makes it possible readily to introduce another colour as required. A nickel-acetate "fixing" treatment improves the light fastness of many organic dyestuffs and also reduces bleeding out of the colour in the seal.

While these large automatic machines naturally arouse much interest there is plenty of scope for the smaller special-purpose automatic machine. For example several installations for anodizing evaporator plates for refrigerators are in existence. One

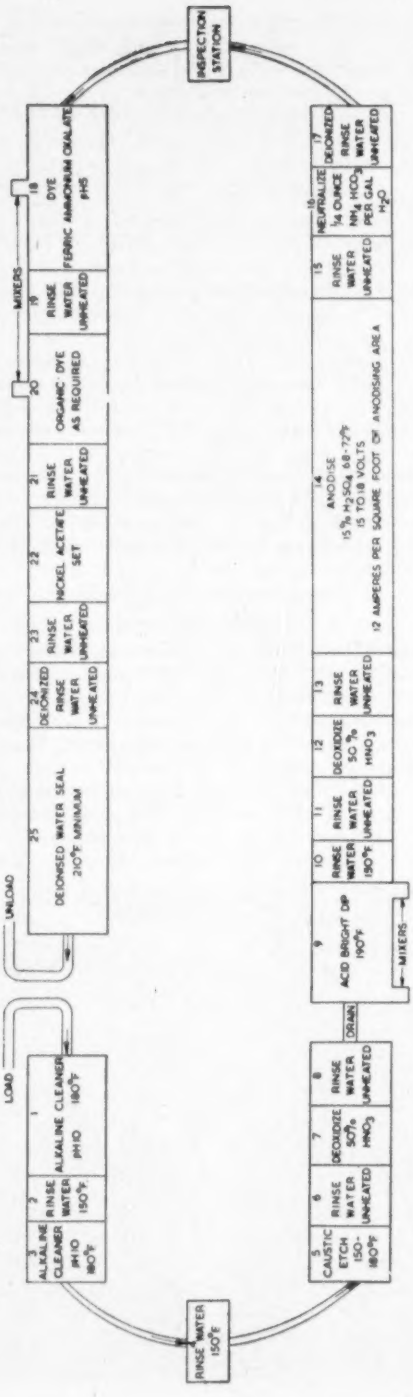


Fig. 6.—Layout of anodizing plant for Firestone Steel Products Co.

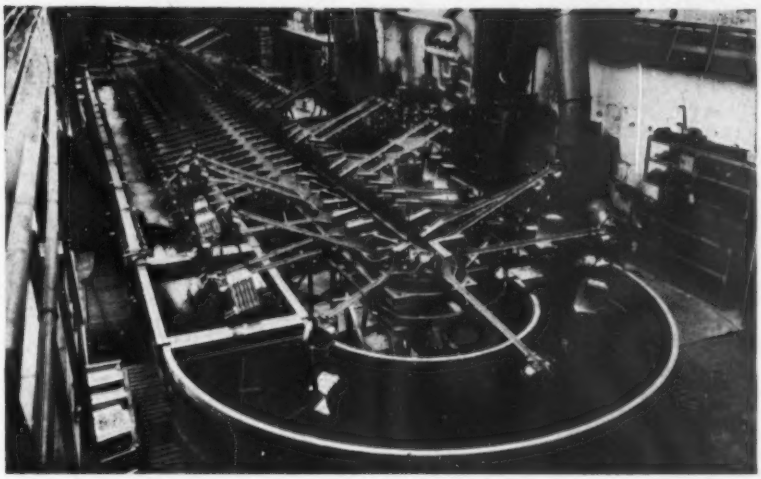


Fig. 7.—General view of automatic anodizing installation for treatment of evaporator plates at Ruanox S.A.R.L. Neuilly-sur-Seine.
(Courtesy of Jean-Pierre Sudre)

installed for Société Rubanox, Levallois-Perret, France, (Fig. 7) provides for the simple cycle of caustic etch—rinse—nitric acid desmudge—rinse—anodize—riuse—seal. A similar installation is at the works of Frigidaire Ltd., London, N.W.9.

Problems in Automation

The first stage in the processing sequence is cleaning. There are a number of possible approaches to this problem and they may each prove satisfactory if the correct principles are observed. Before designing the plant account will be taken of the type of surface contaminant likely to be encountered. Inhibited alkaline cleaners are frequently used for the first operation. It is often desirable to add a second cleaning operation which may employ a very mild etching cleaner if a matt etching stage is not included.

Phosphoric-acid brighteners are reasonably tolerant of small traces of surface contamination but in an automatic plant bad cleaning prior to brightening can result in an accumulation of surface scum which may mar the appearance of the brightening work by adhering to it on removal from the bath. If an alkaline electrobrightening process is used it will normally be preceded by a short etching treatment.

Brightening

There is no doubt that bright anodized finishes have sales appeal and that the demand for them will continue to expand. Chemical brightening in automatic plants introduces problems not present in batch anodizing. One of the first considerations is that the brightener should not cause etching of the component during the time of transfer from the brightening tank to the warm rinse.

Tests made at Aluminium Laboratories Ltd., Banbury, have shown that with Phosbrite 159 an interval of one minute between removal from the brightening solution and introduction of the part into the rinse was without any very obvious effect on the appearance, whereas with Phosbrite 150 there was etching on the cooler edges of the test pressing used. After 30-seconds delay in removal from the brightener there were no ill effects. The precise time which elapses before this etching starts is influenced by the mass of the component, the temperature of the brightener and the shop.

These tests appear to confirm American experience that phosphoric brighteners are suitable for use in automatic plants in that the time required for the component to be transferred from the brightening tank to the rinse tank is such that no etching should occur. In this respect Phosbrite 159 appears to have more latitude than Phosbrite 150.

Another factor influencing the choice of brightener will be the type of articles being processed and their surface condition. Where prior mechanical polishing is either not possible or omitted because of cost, Phosbrite 159 has better levelling characteristics than Phosbrite 150 and will therefore be preferred. The higher nitric-acid content of Phosbrite 159 increases considerably the quantity of brown nitrogen-peroxide fumes evolved. This means that the exhaust on the brightening tanks must be extremely effective and provision made to neutralize these fumes. This can be rather troublesome and costly.

It can be appreciated that phosphoric-acid chemical brightening is not without its difficulties. Apart from the cost of the initial equipment and the problem of fume removal, the drag-out losses can also be appreciable. Estimates suggest that the cost of brightening ranges from sixpence to ninepence per square foot.

There is scope here for research on improved brightening treatments which would be cheaper and would not give such troublesome fumes. In

the meantime there would appear to be good reason to consider using, where practicable, electro-brightening by an alkaline process (such as that known as Brytal) using a sodium-carbonate/trisodium-phosphate mixture. By employing a higher carbonate content than the 15 per cent normally quoted it is possible to get quite good brightening even on commercial aluminium.

Tests carried out at Aluminium Laboratories Ltd., have shown that there is no problem in transfer since a delay of one minute between removal from the brightening bath and entry into the rinse was without effect on the brightness. The pre-etch which is normally recommended can be introduced as a separate operation prior to brightening. The movement of the work through the bath will present no problems since smooth non-turbulent agitation is beneficial. Continuous filtration to remove the aluminium hydroxide produced by the reactions involved would appear to be essential. The drawback to this process is that it has little capacity for removing scratches; this might make it unsuitable for some types of work.

Other electrobrightening processes are available but these are usually based on phosphoric acid so that the drag-out losses tend to make them inherently more expensive. The high operating current densities of around 150 amp. per sq. ft. and the necessity for strong positive agitation make it unlikely that such processes will prove suitable for automation. Certainly much remains to be done in this direction.

Anodizing

By an unfortunate trick of thermo-dynamics and electrochemistry it takes about 16 volts to give an anodizing current density of 12 amp. per sq. ft. the power required appearing as heat once it has passed through the oxide coating. There is usually some additional heat generated as heat of formation of the oxide. To maintain uniformity of the coating it is essential that all of this heat should be quickly removed. This involves cooling of the electrolyte, usually in conjunction with a refrigerator, and agitating it so as to main uniform electrolyte temperature and to prevent the surface temperature of the work rising.

A further unfortunate circumstance is that the best operating temperature range in a straight sulphuric-acid electrolyte is around 70 to 75° F. This temperature range is not easy to maintain by cooling with mains water. Work at Aluminium Laboratories Ltd., suggests that the use of a mixed sulphuric-oxalic electrolyte could enable the operating temperature to be raised to about 85 to 90° F. without loss of properties but with considerable benefit in ease of cooling and control of temp.

The thickness of anodic coating formed in any given anodizing time is directly proportional to the current density, which will normally be 10 or 12 amp. per sq. ft. for bright work and 15 to 18 amp. per sq. ft. for matt finishes. The current density is influenced by the temperature (which should be closely controlled), the strength of the electrolyte and the aluminium content. These latter are bound to vary with the amount of work processed, and it is desirable to use some system of constant current-density control. The acid strength and aluminium content should be checked twice daily and for a 15 per cent (W/V), *i.e.* 3.3 N. electrolyte, the aluminium content should be kept between 5 and 20 gm. per litre.

Dyeing

Consistency of colour is appreciably facilitated by the closer control possible in an automatic plant. One problem is that there is always a tendency to design plants so that the anodizing, dyeing and sealing times are identical. In the case of a 10-minute anodizing time this can give rise to difficulties. Most dyes absorb rapidly in the first five minutes and thereafter more slowly. While some dyes reach saturation in 10 minutes many require 15 to 20 minutes (black 30 minutes) to give maximum absorption. If the dyeing time is too short the light fastness of the dye will be adversely affected and it will be more likely to give rise to colour variations due to minor process variations.

Automatic control of dyebath *p*H is also important. There seems no reason why this could not be linked with two small tanks containing weak solutions of sulphuric acid and caustic soda which could be admitted to the dyebath as required to correct the *p*H. However, a word of warning is necessary regarding this practice. Some dyes will not tolerate the presence of more than a limited amount of sodium sulphate; beyond this limit dyeing may actually cease. Other dyes will tend to change shade and darken with sulphate build-up.

Sealing

Some anodizers have attempted to reduce the number of operations involved in producing colour-anodized finishes by sealing in nickel acetate. This is not a universal solution to the problem and its adoption in automatic plants may give rise to difficulties. Nickel acetate sealing tends to give a white " bloom " on the surface, the extent of this being affected by the dye used, the time, temperature and concentration of the nickel acetate. The light fastness of some dyes may be adversely affected by nickel acetate sealing. The best procedure is to use a short 2-minute " fixing " treatment which can be omitted where it is unnecessary in 0.5 per cent nickel acetate 0.5 per cent boric acid at 80°C. followed by a cold-water rinse and a normal boiling-water seal.

The final operation in the production of anodized finishes is sealing. This is a particularly important

(*Continued in page* 282)

Improvement in the Anodizing Properties and Corrosion Resistance of Aluminium Alloys by HYPER-HOTWORKING*

By J. Hérenguel and P. Lelong
(Centre de Recherches des Tréfileries et Laminoirs du Havre.)

IT is well known that differences in flow speeds associated with the direct extrusion process give rise, in certain zones of the slug and the extruded bar, to particular textures which, on subsequent heating, are areas of special recrystallization (periphery of coarse grains). We further established that these zones involve a considerable reorganization of the heterogeneous "as-cast" structure into a fine and very uniformly dispersed pattern, responsible in certain instances for peculiar surface effects revealed by anodizing[1]. By analogy with normal hot-working, we will call this mechanism "hyper-hotworking."

Pursuing our investigation of the various types of structures present in the extruded bar and in the container, we analyzed micrographically the different zones rather more completely. Changes in structure during flow towards the die appeared as progressive phenomena and different degrees of evolution were found according to the areas explored.

In addition, it was found that several distinct shearing zones exist, while up to now only that leading to the peripheral area of extrudéd sections has been considered.

These phenomena, hitherto often considered as disadvantages of direct extrusion, may be systematically exploited to obtain on metallic materials, certain useful characteristics which cannot be obtained by simple hot-working, by rolling for example.

The elimination of reticulage† apparent on anodizing, already practised for many years[2], arises from these mechanisms. Another recent example of their reasoned application, which the authors are still developing is improvement of the corrosion resistance to high-temperature water of certain aluminium alloys.

A—Structures Found During Direct Extrusion

I. Nature and preparation of the metal examined

The investigations which follow were made on an alloy of the following composition :

Iron : 1.0 per cent
Silicon : 0.003 per cent
Aluminium A9 : remainder.

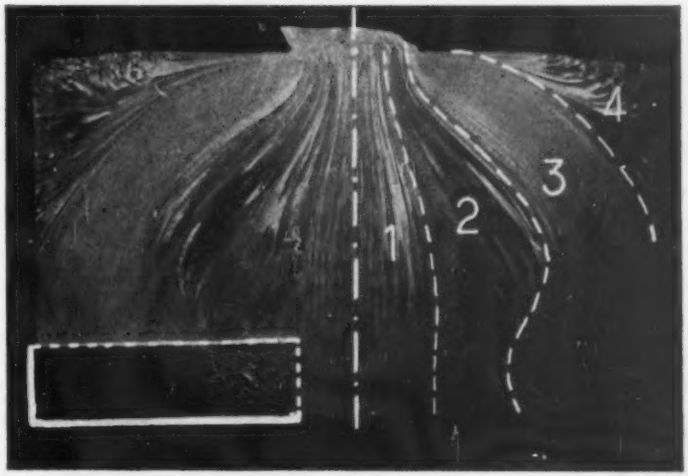


Fig. 1.—(*x* 1 *approx*) *Macrograph of the extrusion slug showing distribution of the various zones.* Bottom left, *mixed sample submitted to corrosion test for* 10*h at* 360° *C.*

* This work was originally described in a paper presented to the Autumn Meeting of the Société Française deMetallurgie, Paris, 9 October 1957

† Reticulage : pattern of defects, developed by anodic oxidation, and due to the separation of insoluble phases on solidification. The precise pattern produced is due to the simple geometrical effects of the various mechanical transformations.

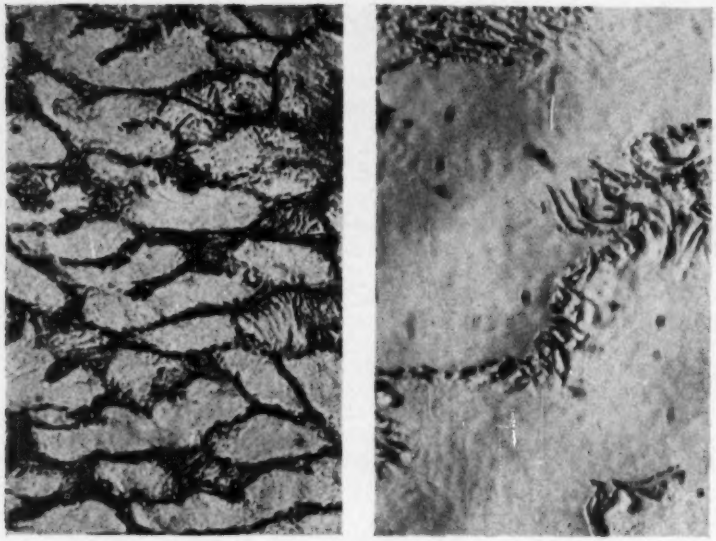


Fig. 2.—Microstructure of zones (2) and (4) of Fig. 1. Chemical polishing. (left) x 100, (right) x 500

According to the equilibrium diagram[3] if complete diffusion of the iron could be achieved so as to attain ideal structural equilibrium, it would only be possible to put at the most 0.042 per cent into solution at the solidus temperature. Almost all the iron is therefore present as a second phase, so long as heat treatment alone is applied.

A billet 100 mm. in diameter and 250 mm. high was cast in a cast-iron ingot mould, to produce relatively slow solidification and a fairly coarse pattern of minor segregation : the changes in this pattern during hot-working are then more easily analysed.

Extrusion was carried out at 400°C., with a straight die, and no sleeving. The extrusion ratio was $\delta = \left(\frac{D}{d}\right)^2 = 25$. Four-fifths only of the length was extruded. The remainder of the slug was recovered for examination of the different zones.

Observations were also made on various samples

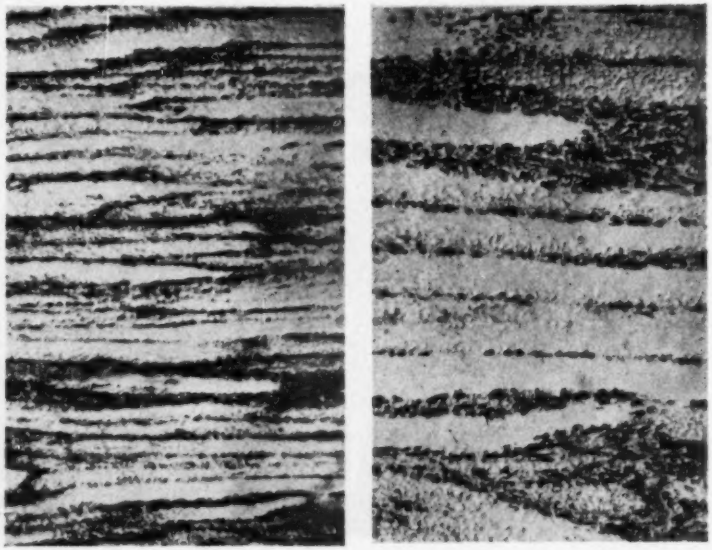


Fig. 3.—Structure of the central zone (1) (left) x 100, (right) x 500.

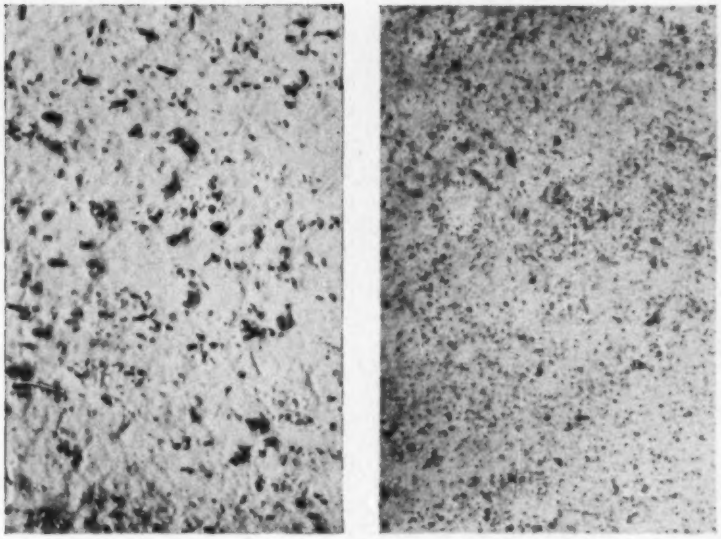


Fig. 4.—Structure of the outer shearing zone (3). (left) *x* 100, (right) *x* 500.

taken from the extruded bar, after they had been rolled. They confirmed that this rolling made little difference to the micrographic appearance : only the elongation of the pattern, already produced by extrusion, was slightly more pronounced.

II. Description of the metal in the container

Fig. 1 shows the macrograph, *i.e.* texture of the extrusion slug.

On the right-hand side the boundaries of the four different zones are marked. Starting from the axis and going towards the periphery, we find :

(1) Central zone with a very elongated fibrous appearance.

(2) Intermediate zone retaining practically the " as cast " structure.

(3) Outer zone of intense shearing between (2) and (4).

(4) Dead corner zone, with practically " as cast " structure as (2).

The micrographic appearance of these zones is as follows :

(*a*) *Zones* (2) *and* (4). These retain practically

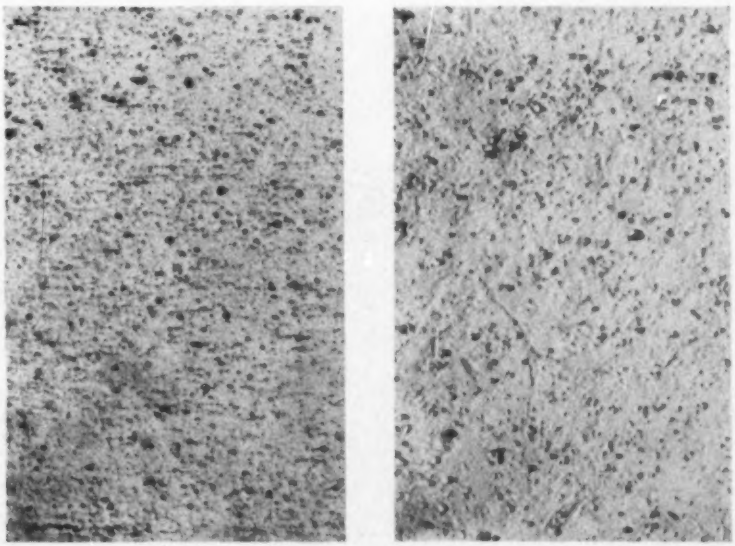


Fig. 5.—Structure of the outer shearing zone in the extruded bar. (last end extruded). (left) *x* 100, (right) *x* 500.

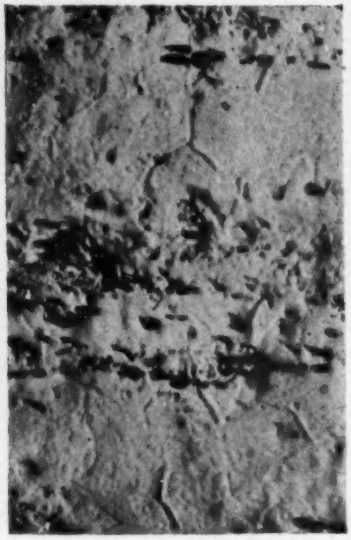


Fig. 6.—Structure of the metal below the shearing zone, in the first end extruded. (left) *x* 100, (right) *x* 500.

the "as cast" structure as shown in Fig. 2 at magnifications of 100 and 500.

The pattern is progressively elongated on either side towards zones (1) and (3). On passing through the die it undergoes simple elongation with fragmentation and alignment of the phases which are out of solution.

(*b*) *Zones* (1) *and* (3). The central zone (1) is extruded more rapidly than the rest of the metal while elongating and undergoing slight shearing relative to zone (2). Its structure (Fig. 3) is still strongly reminiscent of the "as cast" ingot, however, the needles of $FeAl_3$ constituent are already subdivided into numerous small particles.

The structure of the outer sheared zone (3) is shown in the micrographs of Fig. 4. The pattern of heteregeneity is completely different from the preceding one. The $FeAl_3$ constituent is to be found only in the form of fine particles. However, in certain places, a slight alignment, proof of an as yet incomplete redistribution of the coarser "as cast" phases, is still visible. In the slug the alignment is less marked and the structure becomes finer as the die is approached.

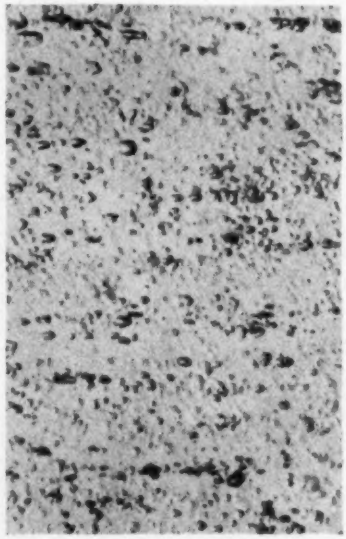


Fig. 7.—Structure of the metal below the shearing zone in the last end extruded. (left) *x* 100, (right) *x* 500.

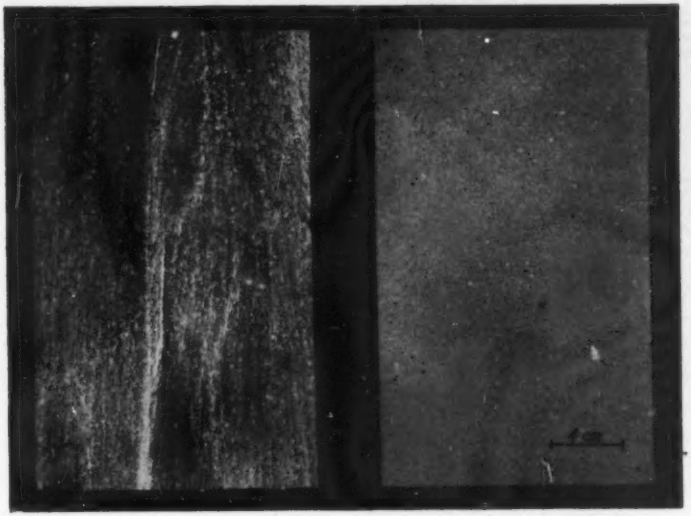
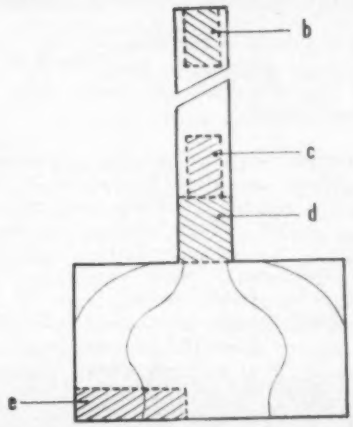


Fig. 8—(left) (x 1) *Appearance of the two faces of the same sheet of A7 aluminium (99.7 per cent.), anodized, obtained by rolling a pre-extruded slab ; the outer shearing zone has been removed from one of the faces.*

Fig. 9.—*Location of the samples subjected to corrosion tests (b) beginning of the extruded bar, skimmed (hyper hot-worked zone removed). (c) End of extruded bar, skimmed. (d) End of extruded bar, unskimmed (with its outer layer of hyper-hotworked metal). (e) Mixed sample taken from the extruded slug. Samples (b), (c) and (d) were subsequently rolled.*



III. Structure of the Extruded bar

It changes progressively from the first to the last end extruded. Nevertheless it can be said that the hyper-hotworked zone exists along almost the whole length of the bar ; the thickness of this zone varies considerably during extrusion. Fig. 5 shows the general aspect of this zone. The uniformity of dispersal of the phases out of solution may be noted : there is no more " white " in the metal and no large aligned groups are to be found. The particles are very numerous and very small ; some are barely resolved by the optical microscope.

It is as though the $FeAl_3$ constituent, in excess according to the solubility limits shown by traditional equilibrium diagrams, were rendered progressively " hypersoluble " during shearing, then reprecipitated when this ceased, on passing out of the die. The " as cast " heteregeneous structure changes to an ultra-fine and regularly dispersed precipitation structure. Immediately below the sheared zone, the structure is scarcely altered except for a process of geometric elongation. Its appearance, at the beginning of the extruded bar, is shown in Fig. 6 and although finer and better distributed in the last end extruded (Fig. 7) it is far from attaining the uniformity and, above all, degree of dispersion of the hyper-hotworked metal of the outer sheared zone.

B—Application to the Elimination of Reticulage

It is known that reticulage is a geometric pattern revealed by anodizing on aluminium alloys containing impurities or additions, normally present in the metal in the form of separate phases.[4, 5] These particles cause defects in the transparency of the alumina film, which are often associated with irregularities in the metal-oxide interface. The defects are directly related to the pattern of minor segregation, geometrically deformed during working : it is a remnant of the heterogeneous " as cast " structure.

By careful choice of the solidification conditions and by refining additions, the pattern of heterogeneities and hence the intensity of reticulage can be considerably reduced[6] ; but, with hyper-hotworking, all the normally insoluble phases can be very much more efficiently dispersed and subdivided in the outer zone of the product, by practising pre-extrusion[2]. Reticulage is then effectively eliminated, however, if the surface layer is removed, reticulage is again found in the subjacent metal. Fig. 8 shows two faces of the same sheet after anodizing, obtained by rolling a pre-extruded aluminium (99.7 per cent) slab which

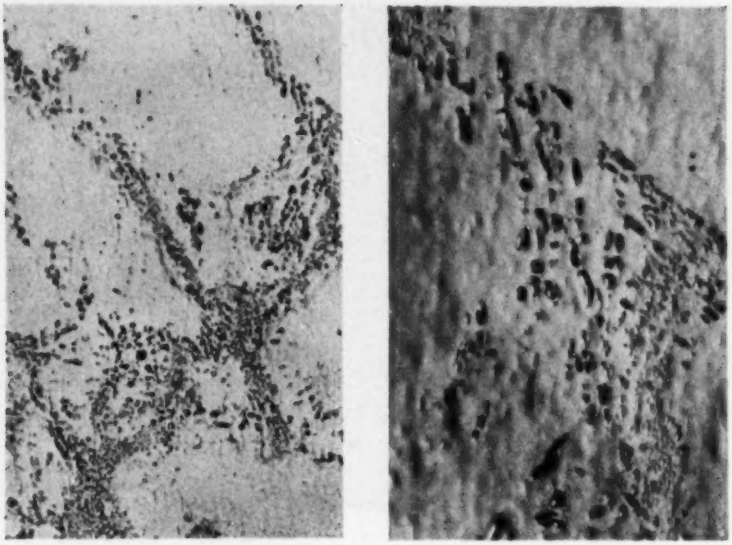


Fig. 10.—Microstructure of a control sample of Al-1% Fe processed by multidirectional rolling (left) *x* 100. (right) *x* 500.

Fig. 11.—(*x* 100) *Various cross-sections of the mixed sample taken from the extrusion slug, after* 10 *hr. exposure to water at* 360°C. (*The structure revealed by light electrolytic polishing*).

was cut in two along the thickness before rolling. The face corresponding to the inside (left) shows marked reticulage while the other (right) has a uniform appearance.

C—Improvement of Corrosion Resistance of Light Alloys to High-Temperature Water

Certain additions in aluminium, particularly iron and nickel, which increase its corrosion resistance to water above 100°C., lead to the formation of insoluble phases as indicated by the equilibrium diagrams. It appeared that these phases protected the surrounding solid solution over a limited area. Hyper-hotworking should therefore, for a given composition, improve the effectiveness of the protection.

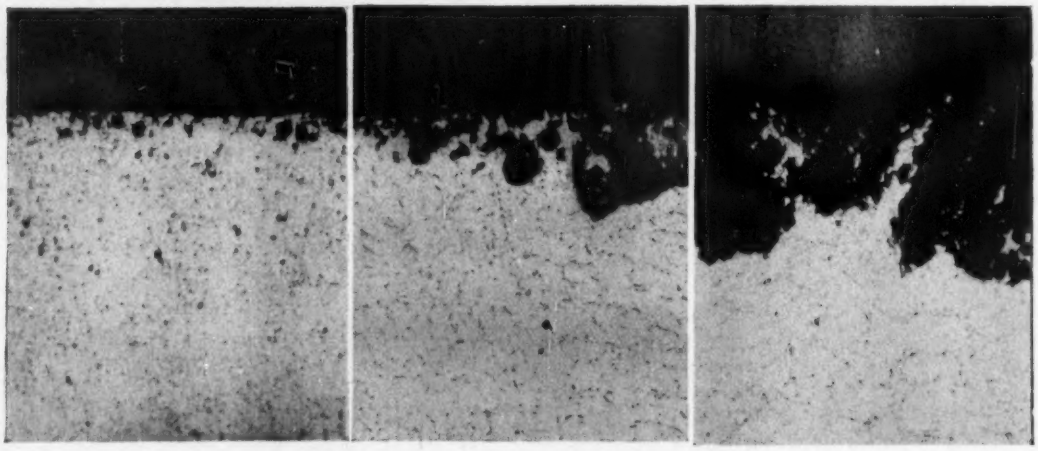
The following experiments confirm this.

A series of samples of the Al-1 per cent Fe alloy previously described, showing the different types of structure, were exposed to the action of degassed ion-exchange water (pH = 6.3 ; resistivity = 640,000 ohm/cm.) for 10hr. at 360°C. Fig. 9 shows how they were selected.

Their behaviour was compared with that of a control sample taken from the same billet but processed solely by multidirectional rolling ; its heterogeneous structure is thus the one shown in the micrographs of Fig. 10. The results of the corrosion tests are described below.

I. Mixed sample from the extrusion slug

It can be seen at the bottom left-hand corner



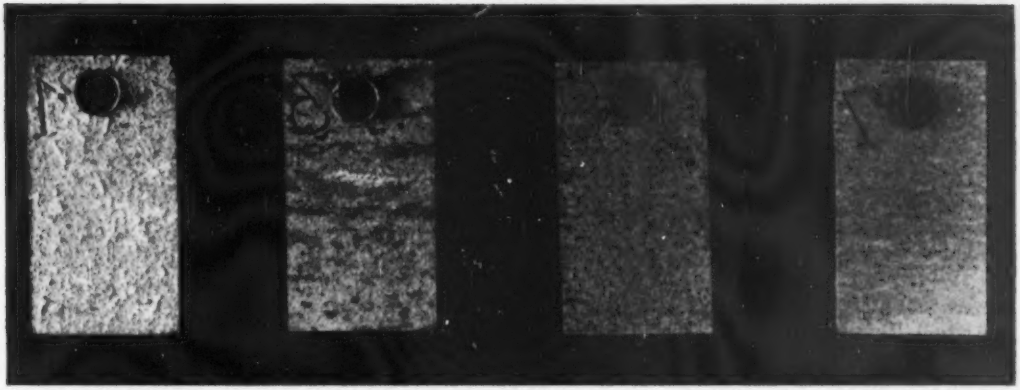


Fig. 12.—(*x* 2.4) *Behaviour towards corrosion by water at 360°C. for ten hours, of the various samples taken from the extruded bar, compared with a sample processed only by rolling. (a) Sample processed by multidirectional rolling (Structure of Fig.* 10) *; (b) Inside of the beginning of extruded bar, roiled. (Structure of Fig.* 6) *; (c) Inside of the end of extruded bar rolled (Structure of Fig.* 7) *; (d) End of extruded bar, rolled (Structure of Fig.* 5).

of Fig. 1 where it has been replaced in the exact position from which it was taken. The surface is divided into two very distinct zones corresponding to the two structures of the metal : the hyper-hotworked zone having the sounder appearance. Micrographic cross-sections confirm this. The micrographs of Fig. 11 show that the differences in depth of penetration of corrosion are directly related to the distribution of $FeAl_3$ (revealed in this case by a short electrolytic polish) on moving from the hyper-hotworked zone ($\frac{5}{3}$) towards the coarse " as cast " structure ($\frac{5}{2}$).

II. Specimens from the bar

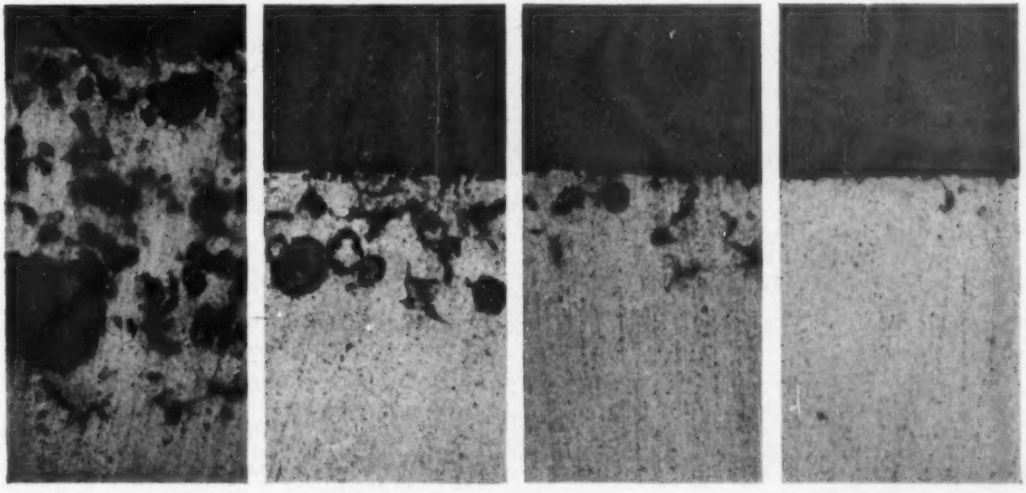
Examination of these completes and confirms the preceding result. In Fig. 12 from left to right, the surfaces of the specimens, rolled (a) and extruded-rolled) (b), (c) and (d), are compared, they are arranged in order of increasing fineness and structural uniformity. Fig. 13 shows the cross-section of the same specimens. There is complete agreement between the micrographic classification of the structures and that indicated by corrosion. The hyper-hotworked metal showed very good resistance except at one or two quite exceptional points.

It can therefore be said that hyper-hotworking, by considerably improving the corrosion resistance of the metal, may be considered equivalent to supplementary protective additions, and can, to a large extent, replace them.

Conclusions

Wrought products produced by direct hot ex-

Fig. 13.—(*x* 260). *Cross-section of the samples in Fig.* 12.



trusion show a number of features peculiar to this method of working.

Certain of these features are advantageous, and this is notably the case with the " presseffekt "[7] thanks to which heat-treatable alloys can be produced with higher mechanical properties than by rolling. On the other hand other features such as the appearance of the coarse grain in the peripheral zone on heat treatment after extrusion, constitute serious disadvantages for which manufacturers must apply various remedies [8, 9].

Hyper-hotworking is the principal metallurgical mechanism associated with direct extrusion; although used empirically, up to now it has not been fully understood. It occurs in zones where the metal deforms with a sufficiently high rate of shearing. This, apart from favouring fragmentation, appears to render hypersoluble the phases out of solution and traditionally considered insoluble, in accordance with equilibrium diagrams established for the metal in the static condition. When shearing ceases, at the die outlet, the normal equilibrium diagram regains its validity and the foreign atoms in excess in the matrix, separate instantaneously in the form of an extremely finely divided precipitate. The structural condition thus obtained can, in the solid state, be further modified, only to the extent of a coalescence produced e.g. by heating for long periods at high temperature.

Up to now, only the heating effect has been considered capable of increasing the tolerance level of a metal to foreign atoms either, by thermal agitation in the solid state, by allotropic transformation or, by transformation to the liquid state. To this must be added a second mechanism : the " mechanical agitation " particularly effective when caused by shearing.

We consider that the alteration in the matrix brought about by this deformation, involves a considerable increase in its capacity to accept foreign atoms, for a given temperature. During deformation the metal thus has properties which approximate it to the liquid state, which in turn makes possible a sort of " hyperhomogeneisation." This to a large extent explains the resulting benefits of hot working, thanks to the accompanying plastic deformation, and the fact that simple diffusion on heating alone, is incapable of effecting solid solution. However, rendering the " insolubles " hypersoluble, followed by an ultra-fine precipitation when shearing ceases, brings about a redistribution that solidification, no matter how rapid, could never achieve.

This work is only a first contribution to the study of the mechanism of hyper-hotworking, illustrated by examples of its calculated use for improvement of the specific uses of certain aluminium alloys.

There is no doubt that more extensive investigation of the mechanism and the factors which control its occurrence will considerably widen its field of industrial application, which extends to all metals and alloys.

Acknowledgments

Part of this work was undertaken within the framework of a research contract placed by the C.E.A. (French Atomic Energy Authority) and we wish to thank M. Salesse, of the Department of Metallurgy and Applied Chemistry, for permission to publish the results. We are also indebted to M. Santini who, at the beginning of these investigations, provided some notable observations and Mlle. C. Lebrun, of our Research Centre, for her contribution to the difficult micrographic work necessitated by our tests.

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Anode Finishes in Automatic Plants

(*Continued from page* 274)

stage in the sequence of operations since it has an important influence on corrosion resistance and serviceability. It is necessary to maintain the temperature as close as possible to boiling point. Equally vital is control of the *p*H at 5.5 to 6.0[5]. With a large automatic plant it may prove difficult to rinse the work entirely free from sulphuric acid although a double rinse (possibly linked with an overhead spray) is of assistance. The plant at Firestone Steel Products Co. uses a weak ammonium-carbonate dip after rinsing. This still leaves the possibility of transferring a weak solution of ammonium carbonate into the seal.

Another aspect of sealing is that if hard mains water is used there will be a gradual build-up of dissolved salts and these will precipitate out on the work. The best method of controlling the sealing water is to institute continuous deionization of the water thus removing both dissolved salts and sulphuric acid carried over into the seal.

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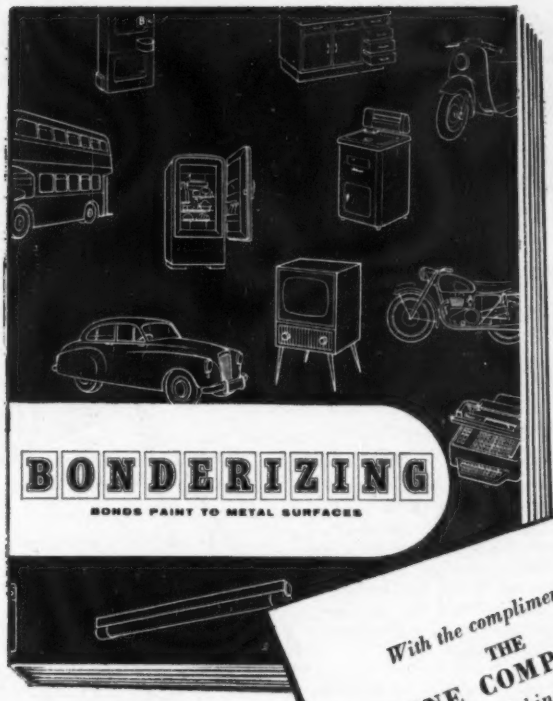

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FINISHING

NEWS REVIEW

I.V.E. CELEBRATES SILVER JUBILEE

Annual Conference in London During Third Week in September

Celebrating 1959 as their silver jubilee year, the Institute of Vitreous Enamellers will be holding their annual conference at London's Park Lane Hotel from September 14 to 19.

The Institute hope to be able to include the papers to be presented in a special edition of their Bulletin, available before the conference begins.

It is hoped that many enamellers from overseas with their ladies will attend this conference, and the council members of the Institute extend to them a very cordial welcome.

Delegates' Programme

Monday, September 14

6.30 to 7.30 p.m. Inaugural reception and official opening of conference and exhibition.

Tuesday, September 15

9.00 a.m. Depart Park Lane hotel for one of the following visits:—

1. Lafarge Aluminous Cement Co. Ltd.
2. Belling and Co. Ltd. and R. & A. Main Ltd.
3. Benjamin Electric Co. Ltd. and R. & A. Main Ltd.

8.00 to 11.00 p.m. Conversazione, Tudor bar, Park Lane hotel.

Wednesday, September 16

9.00 a.m. Depart Park Lane hotel for one of the following visits:—

1. British Bath Co. Ltd. and Aladdin Industries Ltd.
2. General Electric Co. Ltd. and Frigidaire Division of General Motors Ltd.

8.00 p.m. to Midnight Informal dinner dance, Quaglino's, Bury Street, St. James', London, S.W.1. (dress: dinner jackets).

Thursday, September 17

10.00 a.m. Annual general meeting.
10.45 a.m. Presentation of awards.
11.15 a.m. Mellor memorial lecture to be presented by Professor A. I. Andrews, University of Illinois.
1.00 p.m. Luncheon.
2.30 p.m. Technical Session "A"

1. "Fundamentals of Gas Evolution from Vitreous Enamelling"—G. P. K. Chu.
2. "Blistering of Wet Process Vitreous Enamels on Cast Iron — Some Facts and Theories"—E. R. Evans and A. D. Morgan.
3. "Pin Holes and Blistering of Enamelled Cast Iron"—C. A. Sanders.

7.00 to 8.00 p.m. Visit to the Houses of Parliament, cocktails in the Members' dining room and tour of the Houses.

9.00 to 11.00 p.m. Conversazione in the Tudor bar, Park Lane hotel.

Friday, September 18

9.30 a.m. Technical Session "B"

4. "Control of Furnace Temperatures" — W. J. Swinn.
5. "The Correct Use of Fuel Oil and Burning Equipment"—G. O. Fenner.
6. "Refractories" — D. Dixon.

1.00 p.m. Luncheon.
2.30 p.m. Technical Session "C"

7. "Methods of Decoration used in the Ceramic Industries" — Dr. W. L. German.
8. "A Critical Assessment of Vitreous Enamel in the Home"—Miss J. E. Walley.
9. "Effects of Detergents"—sub-committee report.

7.30 for 8.00 p.m. Annual banquet (evening dress and decorations or dinner jackets).

Saturday, September 19

10.30 a.m. Technical Session "D"
10. "Interface Phenomena in Enamels" and film—F. Rickmann.

Ladies' Programme

Tuesday, September 15

10.30 a.m. Depart Park Lane hotel for tour of London.
8.00 to 11.00 p.m. Conversazione, Tudor bar, Park Lane hotel.

Wednesday, September 16

3.30 p.m. Dress show, Michael's, 2, Carlos Place, London, W.1.
8.00 p.m. to Midnight Informal dinner dance, Quaglino's, Bury Street, St. James', London S.W.1. (cocktail dress).

Thursday, September 17

10.30 a.m. Excursion to Windsor and the Thames Valley, including visit to Windsor Castle and luncheon.
7.00 to 8.00 p.m. Visit to the Houses of Parliament, cocktails in the Members' dining room and tour of the Houses.
9.00 to 11.00 p.m. Conversazione in the Tudor bar, Park Lane hotel.

Friday, September 18

12.30 p.m. Floral arrangement demonstration by The Constance Spry Flower School, and luncheon, at the Dorchester hotel, Park Lane, London, W.1.
7.30 for 8.00 p.m. Annual banquet (evening dress).

"Tyrolit" Agency

A MIDLANDS firm, Flexible Drives (Gilmans) Ltd., Carlton House, High Street, Smethwick, Staffs., have recently been appointed sole distributing agents for "Tyrolit" profile grinding wheels and shapes and "Tyrolit" Secur cutting off discs in the U.K., India, Australia, New Zealand, Eire and all colonies of the British Commonwealth.

Travelling spray booth for rolling stock

A TRAVELLING spray booth developed by the Aerograph-DeVilbiss Co. Ltd., 47, Holborn Viaduct, London, E.C.1., has been designed for painting rolling stock.

In operation, the booth straddles the vehicle to be painted and travels backwards and forwards under its own power at any speed up to 25 ft. per min., filtering, washing and exhausting the air from the painting area that contains a certain amount of overspray. Electric power supply to the booth is through a feed rail running the full length of the shop, with a pick-up arm mounted on top of the booth.

General Layout

The booth is an arch, measuring 12½ ft. long, 17½ ft. wide and about 16½ ft. high from the floor, and runs along rails parallel to but wider than the normal gauge rails.

On each side of the booth, there is a 7 ft. long compartment for the painter, who stands on a steel floor that he can raise or lower to the desired working height by compressed air. The painter can cover the ends of a vehicle by lowering a hinged steel extension ; electrical interlocks prevent movement of the booth while an extension is in use.

Each platform is fitted with an air transformer and pressure regulator to which the painter attaches a standard pressure painting unit by hose. Each operator adjusts the height of his own platform and the chief operator controls the positioning and movement of the booth by a switch operating electrically-powered hydraulic motors driving road wheels through V-belts and reduction gear : emergency stop buttons are located on each platform.

Lighting is by vertical banks of 5 ft. glass-enclosed, explosion-proof fluorescent fittings, designed to give good working conditions. On each side of the booth, an air wash exhaust system, water pump, exhaust fan, air regulator, air compressor and explosion-proof electrical control system are fitted.

Two 10-h.p. compressors of two-cylinder single-stage air-cooled type, driven through V-belts by electric motors, supply air at 100 lb. per sq. in. to provide the power for actuating the platforms and operating the spray guns. The air pressure for the guns is adjusted by air transformers attached to each platform. The air wash units comprise water supply tank, air washing sections, overflow, drain and pump intake connections, drain sump with strainer and pump intake strainer screens.

Exhaust Arrangements

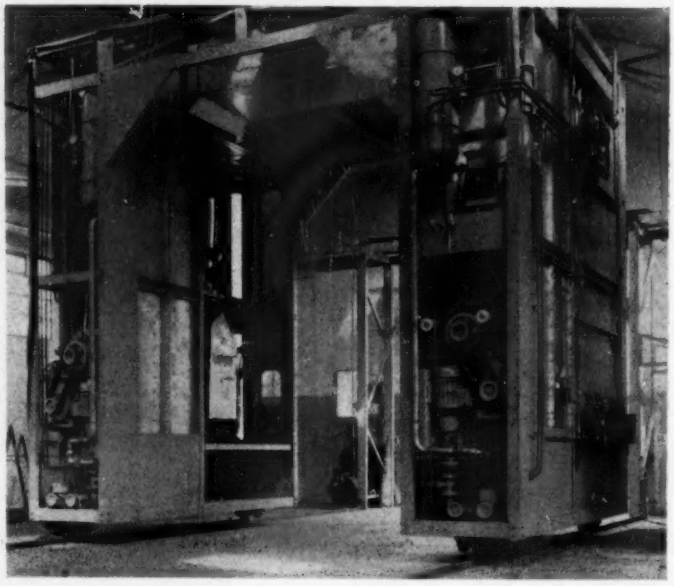
When spraying is being carried out, the booth-mounted exhaust fans draw the overspray through high pressure water sprays in the air wash chambers, where the air is cleaned of paint particles and discharged into exhaust ducts feeding into a fixed exhaust duct covering the centre line of the track.

So that the exhaust can be taken to outside atmosphere, the bottom of the duct consists of a series of pivoted louvres opened by cams on the top of the booth. Two input fans are situated in the roof of the booth immediately over the operator's area, connected to a glass-fibre type filter box.

Fire Precautions

A completely automatic fire extinguishing system is installed in the booth. At any temperature above the setting of fusible bulbs fitted in the booth, an automatic electric switch cuts out, stopping the exhaust fans and causing baffle plates to drop over the exhaust openings adjoining the painter's platforms. Carbon dioxide, stored in pressure cylinders, is then immediately released and blankets the spraying area.

▼ *Protective wire guards have been removed in this picture to show mechanical details of the booth*



Plant for chemical polishing

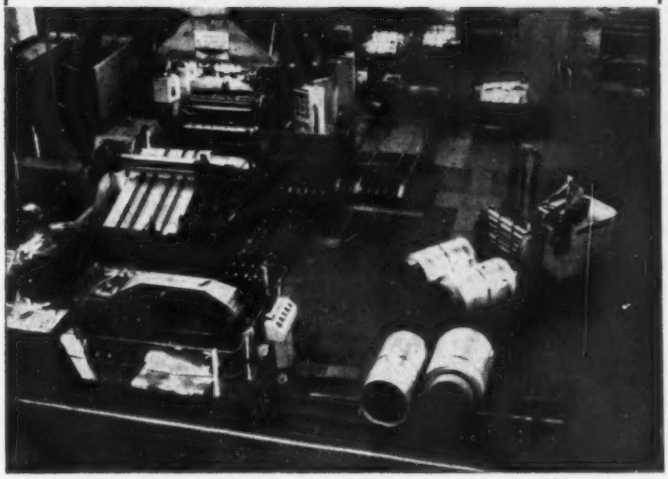
Stainless steel and PVC in Griffiths unit

COMPLETE installations for chemical polishing using the Phosbrite processes manufactured by Albright and Wilson (Mfg) Ltd. are now being constructed by A. E. Griffiths (Smethwick) Ltd., Booth Street, Handsworth, Birmingham 21.

Tanks for the installations are constructed of stainless steel, fitted with thermostatically-controlled electric heating elements. A fume extraction system, comprising a hood with built in scrubber unit, fan and connecting ducting, is manufactured from laminated P.V.C.

The installation is suitable for Phosbrite solutions 150-159 (aluminium and its alloys), 183 and 184 (single-phase brass, gilding metals of pure copper and nickel silver), and 501 (stainless steel).

ICI–ALCOA Aluminium Link-up



Section of the strip rolling plant at Waunarlwydd Works, Swansea

IMPERIAL ALUMINIUM CO. FORMED

Britain's Imperial Chemical Industries Ltd. has entered into an agreement with the Aluminum Co. of America (ALCOA) to collaborate in the manufacture of wrought aluminium products.

ALCOA is the largest producer in the world of primary aluminium and wrought aluminium products. Founded in 1888, it has built up a p imary metal capacity in the United States approaching 1,000,000 tons yearly, and extensive production facilities for wrought products. ICI's Metals Division has been engaged in wrought aluminium production for over twenty years, and at the request of H.M. government undertook the construction and operation of plants for aluminium rolling and extrusion to supply material urgently required for the war-time aircraft construction programme. The plants, at Waunarlwydd, near Swansea, South Wales, were bought by ICI after the war and have recently been modernised and extended.

British control retained

The two companies will establish a new company, to be registered as Imperial Aluminium Co. Ltd., to which ICI's aluminium plants at Waunarlwydd will be transferred, and which will manufacture the wrought aluminium products now being sold by ICI and any others it is subsequently decided to produce. Initially, at least, these products will be sold through the existing ICI selling offices.

ICI will hold 51 per cent and ALCOA 49 per cent. of the capital of the new company, and ICI will appoint three of the five directors, including the cha rman and managing director. Control therefore will remain in British hands. At the same time the accumulated experience and technical resources of ALCOA will be available to the new company. ICI's general personnel policy will apply to the new company, which, apart from a limited number of technical staff on secondment from ALCOA, will employ U.K. staff and workers.

D.S.I.R. TECHNICAL DIGESTS BACK AGAIN

THE technical digests issued by D.S.I.R. that proved so popular during an experimental try-out two years ago are once again being published.

Over three hundred technical periodicals are published in this country—carrying a vast number of novel ideas and new techniques. Only the largest organisations, with their own information services and libraries, are able to digest everything of potential value. The average industrial firm probably limits its reading to a small number of journals concerned with its special field of interest. It may miss developments in a different field which could be applied to its own problems. The technical digests should be valuable in pin-pointing new ideas and — at least as important — the sources of information about them.

The digests will be published monthly. Annual subscription is 3 gns. for sets of 15 items per month. To encourage large firms to distribute digests among their staff, a reduction will be offered for quantity supplies.

Aluminium foil is fruit ripener

MAKERS of aluminium garden foil report increasing interest in the material by gardeners and horticulturists. When laid between rows of plants the foil has several advantages ; apart from eliminating weeds it keeps the moisture in the soil and traps the sun's heat to boost plant and vegetable growth. For ripening fruits such as tomatoes and strawberries, foil placed under the plants hastens the growth of the fruit by reflecting the sun's rays to give all round ripening.

Ransburg win patent suit in U.S. District Court

IT has been reported that on June 18 Judge Cale J. Holder of the United States District Court at Indianapolis upheld as valid the basic airless electrostatic spray coating method and apparatus patents issued in August 1954 and June 1957 to the Harper J. Ransburg Co. of Indianapolis, U.S.A. The action was in a suit brought by the Binks Manufacturing Co. of Chicago.

Not only were the patents upheld, but the court also found that the use of the Binks SK-661 device in an electrostatic spray painting system infringed the patents, and further use was enjoined. The court also held that Ransburg had not misused its patents or violated the anti-trust laws, or engaged in unfair competition as charged by Binks. The Court also found that Ransburg is entitled to damages and attorney fees.

The litigation was commenced by Binks in October, 1956.

Sulphuric Acid Output on Schedule

Long Meg Mine Celebrates Millionth Ton

THE millionth ton of anhydrite was shipped with ceremony from the Long Meg Mine, near Penrith, to the converters in Widnes recently.

This figure represents the output of the mine in the last four years and achieves the target of a quarter of a million tons a year which was set when the development project started.

At the ceremony, the chairman of United Sulphuric Acid Corporation, Mr. R. J. Kerr-Muir, O.B.E., pressed a button releasing the millionth ton into a railway wagon specially decorated for the occasion.

Anhydrite, once almost valueless commercially, suddenly became more valuable when a process was perfected for obtaining sulphuric acid from it. To exploit this discovery, the United Sulphuric Acid Corporation was formed in 1952 by eleven major users of sulphuric acid and a £4 million factory was built at Widnes.

The small, century-old Long Meg mine at Langwathby became the scene of enormous activity with new buildings being erected, plant installed, a new metalled road and a new railway siding. The Long Meg Plaster & Mineral Co. Ltd., one of the Gotham Group of Companies, agreed to keep the new sulphuric acid plant at Widnes supplied with anhydrite for twenty years.

Corrosion engineers association formed

THE formation of the British Association of Corrosion Engineers was announced recently.

The objects of the Association will be generally to promote the dissemination of technical information about corrosion matters and to develop by means of social activities the free interchange of information among members. In due course the Association, which is non-profit making, will progress towards the establishment and acceptance of suitable qualifications for corrosion engineers, and the promotion of standardisation in the terminology and techniques of corrosion control.

When the Association is in full operation it is intended to hold full-scale meetings with papers, films and discussions. Details and membership application forms can be obtained from the Hon. Secretary, British Association of Corrosion Engineers, 97 Old Brompton Road, London, S.W.7.

Baldwins Change Company's Name

THE name of the Baldwin Instrument Co. Ltd., Dartford, Kent, has been changed to Baldwin Industrial Controls, a name which the company thinks more clearly illustrates the company's service to industry.

Expansion and development in two fields the company have taken up — nucleonic thickness and control gauges, and fluid power — have necessitated a recent move to much larger premises in the centre of Dartford.

Change of Address

THE Reddish Chemical Co. Ltd. manufacturers of detergents for the dairy, brewery and industrial fields, have moved from Reddish, Stockport, to Globe Works, Stanley Road, Cheadle Hulme, near Stockport, Cheshire. Telephone : Hulme Hall 4406.

CHROMIUM PLATED C.I. SEALING RINGS FOR ROLL BEARINGS

THE metal products division of Koppers Co. Inc., Baltimore, Md., U.S.A., recently announced the development and perfection of a chromium-plated cast iron sealing ring claimed to greatly reduce oil loss on backup roll bearings in steel strip mill operations. A number of the rings have been in use at a large U.S. east coast steel plant as a test project for over two years and "have cut oil losses to a minimum, significantly decreased oil contamination and extended the life of bearings." The rings are claimed to be made more cheaply than other metallic rings.

"Two-thou" chrome layer

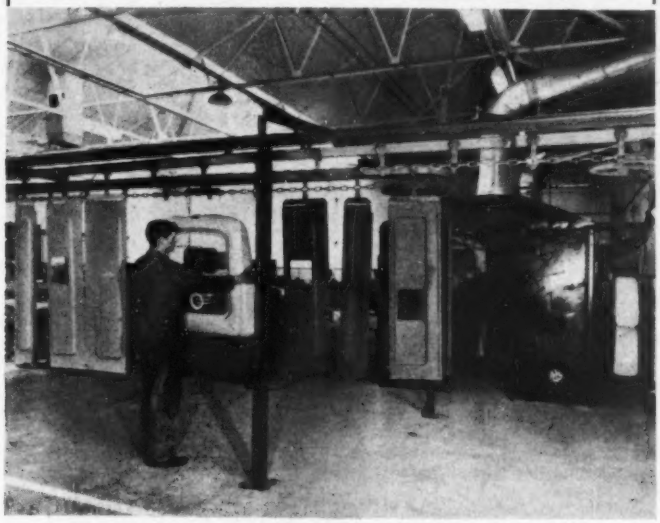
Reference to results obtained from use of the cast iron rings were recently made in a paper entitled "Maintenance of Backup Roll Bearings on Strip Mills" presented to the Association of Iron and Steel Engineers.

The rings have a 0.002 in. layer of chromium on the wearing surfaces and are said to last from three to five years without replacement.

SEL-REX AT U.S.A. FAIR IN NEW DELHI

A VIEW of the Sel-Rex Corporation's (Nutley, N.J., U.S.A.), exhibit during a demonstration of bright gold electroplating at the United States Small Industries Fair, held recently in New Delhi, India. Several Indian manufacturers are said to have inquired about installing comparable equipment and processes, among them a metal eyeglass frame manufacturer, and a producer of religious and emblematic jewellery.

Atlas Copco's New Factory



A view of one of the factory's paint spray booths

A NEW £¼-million factory at Maylands Avenue, Hemel Hempstead for Atlas Copco (Great Britain) Ltd., was officially opened by Lord Mills, K.B.E., the Minister of Power.

Situated on a 6¾-acre site, the factory and offices have a floor space of 78,200 sq. ft. Permanent external walls are of facing brick and patent glazing, with window frames in anodized aluminium and vitreous enamel.

Future expansion plans for the factory include an additional 15,000 sq. ft. office accommodation and 130,000 sq. ft. of factory space.

The move from the company's old factories at Glasgow and Wembley took just over a year, but during this time Atlas Copco produced nearly 400 portable compressors and 1,000 pneumatic tools at the new factory alone. Despite the difficulties caused by the move, production during the first six months of this year showed an increase of 40 per cent. over the corresponding first six months of 1958.

MORE TOOK INST. OF PHYSICS EXAMINATIONS

THE report of the Institute of Physics for 1958 published recently records that at the end of the year a circular was sent to members proposing the amalgamation of the Institute and The Physical Society and that if the broad basis of intention was accepted a joint committee would be set up to work out all the details ; it is understood that a scheme for amalgamation has been submitted to members of both bodies.

Eighty candidates took the recently established graduateship examination, and twenty-six satisfied the examiners. In 1958, 637 students took the ordinary national certificate examination and 246 the higher national certificate examination in applied physics (compared with 542 and 182 respectively in 1957).

Besides the normal work of the Institute, the report recordsexpanding activities in many fields including education, scientific publications, conferences and symposia and other meetings arranged by the Institute's branches at home and overseas and by its specialist subject groups.

GEC-WB joint service

THE General Electric Co. Ltd. and Wild-Barfield Electric Furnaces Ltd. jointly announce that the repair and maintenance service for all G.E.C. valve-operated high-frequency generators will be carried out by Wild-Barfield Electric Furnaces Ltd. from their works at Otterspool Way, Watford By-Pass, Watford, Herts. Telephone : Watford 26091.

Plating Shop Effluent Contract

A CONTRACT has been recently placed by Siemens Edison Swan with the Kestner Evaporator and Engineering Co. Ltd., London, for a Kestner installation to neutralise the acid effluent from their plating shop. As is generally known, Kestners have specialised in this type of installation for many years.

The new contract, to be installed at Siemens works at Woolwich, will consist of four patent continuous neutralising units with the necessary ancillary plant. The whole will be in the firm's structural corrosion resistant plastic, Keebush, and will include their acid-liquor pumps.

ICI—ENGELHARD ELECTRODES PACT

AGREEMENTS covering the production and sale of platinum-titanium electrodes have been signed by Imperial Chemical Industries Ltd. and Engelhard Industries Inc., New Jersey, U.S.A. The production of platinum-titanium electrodes by the Metals Division of Imperial Chemical Industries Ltd. is now well established ; Engelhard Industries Inc. will produce similar electrodes at their factory in the U.S.A.

The electrodes are used for the production of chemicals such as chlorine, and for cathodic protection against corrosion. Considerable research is also being conducted into the use of such electrodes in electrodialysis (the conversion of brackish water or sea water to drinking water), electro-descaling, electro-reduction, and similar processes.

Engelhard Industries Inc. has fifteen divisions and several associated companies, and is one of the world's largest fabricators and refiners of precious metals, sold almost entirely for industrial and chemical purposes. Imperial Chemical Industries Ltd., pioneer of the British titanium industry, has outstanding facilities for the extraction and manufacture of the metal and has made many notable contributions to titanium technology.

The two organisations will institute a continuing joint research programme and will pool all information acquired.

Technical & Industrial Appointments

Staff changes in industry are dominated this month by the news from The Mond Nickel Co. and its subsidiary Henry Wiggin and Co.

Dr. W. Steven, superintendent of the development and research department laboratory of **The Mond Nickel Co. Ltd.** in Birmingham has been transferred to the development and research division of The International Nickel Co. Inc., New York, as director of research. He has also been elected an assistant vice-president of that company.

After 5 years with William Jessop and Sons Ltd., Sheffield, Dr. Steven joined The Mond Nickel Co. in 1947 as a research metallurgist. In 1955 he was appointed superintendent of the laboratory.

Dr. G. L. J. Bailey has been appointed superintendent of the development and research department laboratory in Birmingham.

After experience at the Admiralty Engineering Laboratory, West Drayton, he joined the British Non-Ferrous Metals Research Association, where he became deputy research manager. Since 1955 he has been superintendent of the platinum metals research laboratory of the development and research department. The Mond Nickel Co. Ltd., Acton.

Dr. W. Betteridge has been appointed superintendent of the platinum metals research laboratory of the development and research department at Acton.

After serving with Joseph Lucas Ltd., and the Bristol Aeroplane Co., Dr. Betteridge joined Mond Nickel in 1947, where he has been concerned primarily with the development of high-temperature materials, at first in the Birmingham research laboratory and more recently as development officer in London.

* * *

Mr. J. Stuart Anderson who resigned recently as deputy provincial treasurer of the Province of Manitoba, Canada, has been elected assistant to the vice president and also assistant treasurer of **The International Nickel Co. of Canada, Ltd.**

Mr. Anderson has also been elected assistant vice president and assistant treasurer of The International Nickel Co. Inc. the company's United States subsidiary.

Mr. Anderson had served as deputy minister of the Finance Department of Manitoba since 1950.

* * *

The following organisational changes in **The Mond Nickel Co. Ltd.** and its subsidiary company, **Henry Wiggin and Co. Ltd.** have been announced.

Mr. L. H. Cooper relinquishes his positions as chairman and director of The Mond Nickel Co. and Henry Wiggin and Co. Mr. G. Archer becomes chairman of Mond and Wiggin, succeeding Mr. Cooper in these capacities.

Three managing directors of Mond are appointed, namely, Mr. I. A. Bailey managing director (operations); Dr. L. B. Pfeil managing director (research and technical); Mr. J. O. Hitchcock managing director (commercial). Mr. Bailey will continue as managing director of Wiggin, and Dr. Pfeil and Mr. Hitchcock continue as directors of that company.

Dr. A. G. Ramsay becomes a director of Wiggin and continues as the director of Mond, resident at Clydach, Swansea.

Mr. F. Dickinson becomes a director of Mond and continues as manager of the development and research department of Mond.

Mr. F. B. H. Howard-White and Mr. R. A. R. Hill relinquish their respective positions as secretary and comptroller of Mond and Wiggin and continue as directors of both companies.

Mr. E. Vaughan and Mr. D. Parry Davies become secretary and comptroller respectively of both Mond and Wiggin.

Mr. C. W. R. Edwards becomes chief legal officer of Mond and Wiggin and continues as assistant secretary of both companies.

* * *

Geigy (Holdings) Ltd. of Manchester have announced that the Rt. Hon. The Lord Rochdale, O.B.E., T.D., D.L., has accepted a seat on their board.

Lord Rochdale is chairman of Kelsall and Kemp Ltd., wool textile manufacturers in Rochdale, and of its associated company in Tasmania; chairman of the Cotton Board and a past president of the National Union of Manufacturers; he has recently completed his term of appointment as a member of the board of governors of the B.B.C.

* * *

Heat and Air Systems Ltd., 172 Buckingham Palace Road, London, S.W.1., have announced that Mr. F. A. Barker, manager of their Stockport branch, has been appointed to the board.

At the annual general meeting of the **Plant Lining Group** of the Federation of British Rubber and Allied Manufacturers, held in London recently, Mr. T. H. Brooke, managing director of Redferns (Bredbury) Ltd., was re-elected chairman for 1959-60. Mr. A. E. Allcock, of the Dunlop Rubber Co. Ltd., was elected vice-chairman.

Members of the Plant Lining Group are: B.T.R. Industries Ltd., Dexine Rubber Co. Ltd., Dunlop Rubber Co. Ltd., Nordac Ltd., Redferns (Bredbury) Ltd., St. Helens Cable and Rubber Co. Ltd.

* * *

At the annual general meeting of **The Institute of Physics** held in London recently, Sir George Thomson (Master of Corpus Christi College, Cambridge) was re-elected president.

Dr. J. M. A. Lenihan was elected a vice-president; Dr. J. Taylor, honorary treasurer, and Professor F. A. Vick, honorary secretary, were re-elected. The two new ordinary members of the board elected were Dr. V. E. Cosslett and Mr. L. Rotherham.

* * *

Mr. I. H. Gordon has been appointed assistant sales manager of **Cambridge Instrument Co. Ltd.,** at the company's head office in London.

The appointment is part of the expansion of the company's sales organisation. Mr. Gordon will provide additional liaison between head office and the company's branch offices, and will assist sales promotion generally.

Previously Mr. Gordon was southern area manager of Land Pyrometers Ltd., and, prior to that, was with Evershed and Vignoles Ltd.

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The O. Hommel Co., Pittsburgh, Penna, U.S.A., has expanded its sales staff in the chemical and equipment division with the appointment of Mr. Leonard N. Wolf. Mr. Wolf will be primarily concerned with sales of aluminium pigments, alcohols, chemicals, oils and specialities.

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Mr. P. T. Butler, previously a buyer with Coldair Ltd., and Mr. N. E. Griffiths, formerly with British Paints Ltd., have been appointed sales representatives with **Anti-Dust Services Ltd.,** Dudley, Worcs.

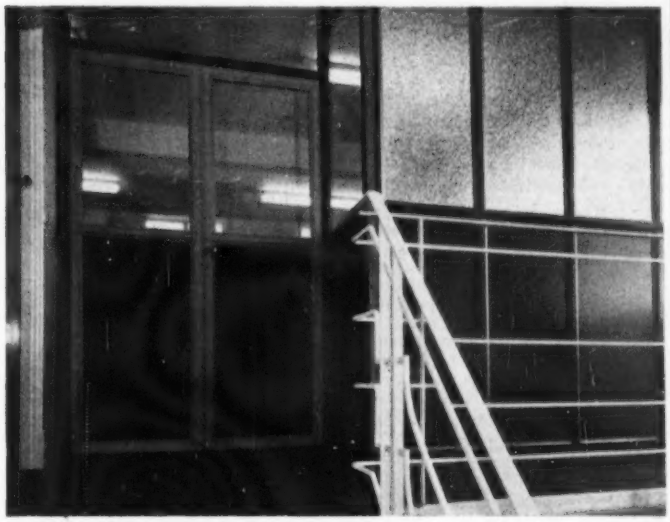
Mr. Butler will be covering the south London and south-east England area, and Mr. Griffiths the north of England, and Scotland.

U.S. "Iridite" products made by Cruickshanks

IT was reported during August that T. Cruickshank Ltd., Camden Street, Birmingham, chemical manufacturers and metal finishing specialists, have concluded an agreement with Allied Research Products Inc., Baltimore, Md., U.S.A., under which the British company has been granted an exclusive licence for the manufacture and sale in the U.K. of a wide range of "Iridite" products.

Corrosion Inhibitors

These are used in processes for the prevention of metal corrosion. The agreement also provides for the sale of these products by Cruickshank in certain countries overseas. A licence to use the Iridite trademark has also been granted.



THE plastic-coated steel sheet produced by John Summers and Sons, Ltd., "Stelvetite" is now being used as panels in the manufacture of doors, partitioning and curtain walling.

Manufacturers are Ideal Casements (Reading) Ltd., sole licencees in the U.K. for the "Mipolam" process. Basis of this is a hollow steel square section having a P.V.C. extruded profile to provide a cover resistant to corrosion.

The Mipolam profiles are designed for double glazing or panelling to exclude dust or moisture. Heat losses are reduced by up to a third and the sound insulating effect is that of a 4-in. brick wall, it is claimed. Stelvetite is used for the panels between the framework.

The partitioning shown above has been erected in the offices of Ideal Casements. Colour effects chosen are cherry red Stelvetite having a grey seal-embossed inside surface, with a panel of insulating material in between.

NEW COMPANIES

"Ltd" is understood also "Private Co." Figures = Capital, Names = Directors, all unless otherwise indicated.

Diagrit Electrometallics, Pattenden Lane, Marden, Kent. April 24. £6,000. To carry on bus. of electro, nickel and chromium platers, etc. John C. F. Dawkins and Joyce G. Dawkins.

Cheltenham Panel and Spray, Imperial Sq., Cheltenham, April 24. £2,000. To carry on bus. of manufacturers of motors and motor vehicles, coach painters, panel makers, etc. E. D. Barnfield, Wilfred B. Cripps.

F. Higgins, 47, Brass Street, Birmingham. April 24. £100. To carry on bus. of metal polishing, etc. Frederick Higgins and Mrs. Jessie Higgins.

Flockostat Sales. April 27. £100. To carry on the bus. of manufacturers of and dealers in apparatus for affixing to materials, coatings of animal, vegetable and mineral fibres.

Horninglow Plating (Burton-on-Trent), Church Croft, Horninglow Street, Burton on Trent. April 27. £100. Mrs. Barbara J. Cooper, Richard B. Cooper and John G. Cooper.

A. B. Morgan, 26, Westbourne Street, Walsall. April 29. £2,000. To carry on bus. of polishing and finishing of manufactured goods of all kinds, etc. Albert B. Morgan and Mathilda I. Morgan.

Jack Geary, The Friars, 154, Upper New Walk, Leicester. April 29. £1,500. To carry on bus. of merchants of and dealers in cleaning and polishing fabrics, etc. Jack Geary and Mrs. Irene Geary.

Blasting and Coatings, May 6. £100. To carry on the bus. of surface treating of metals, wood, plastic, etc. Arnold Coy, Albert E. Cole, Peter B. Wharton.

S. M. Alexander, 29, Museum Street, London, W.C.2. May 7. £75,000. To acquire from S. M. E. Alexander the goodwill and assets of the bus. of craftsmen in high frequency sealing of plastic films carried on at Bridge Works and 215, Upper Street, N.1. as "S. M. Alexander & Co.", etc.

Tretol-Servicised. Tretol House, The Hyde, N.W.9. May 6. £9,000. To carry on bus. of manufacturers of and dealers in all types of bituminous rubber compounds and elements thereof, etc. Sally Trisk, Hedwig Wolff, David A. Jacobs and John Hurst.

Warrington Chemical Plumbing and Welding, Bank Street, Warrington. May 6. £5,000. Jas. W. Weston, Samuel G. Cartwright, Edwd. Capper, Joan L. Weston, Lillian Cartwright and Ethel Capper.

Albion Paints. May 8. £100. To carry on bus. of manufacturers and merchants of varnishes, japans, enamels, lacquers, etc.

A. Hanley and Son, Midland Bank Chambers, Charles Street, Sheffield, 1. May 11. £1,000. To carry on bus. of manufacturers, patentees and suppliers of industrial safety appliances, including protective and industrial clothing, etc. Vincent Hanley, Ronald V. Hanley, Elizabeth Hanley.

Sears Pipework Installations. May 11. £5,000. To carry on bus. of manufacturers of and dealers in plant, machinery and equipment, particularly relating to the fabrication and installation of gas, water, oil and chemical plant, pipes, pipework, etc.

From the Register compiled by Jordan & Sons Ltd. 16 Chancery Lane, London, W.C.2.

Tinplating Plant for Poland

BRITISH tinplating plant to be supplied by the Head Wrightson Machine Co. Ltd. will treble Poland's present output of tin plate.

Head Wrightson's Mr. Gowthorp, in the centre, is seen above signing the contract awarded to the company by Centrozap, the official Polish government agency. The order, worth £180,000 for the two hot-dip tinning lines to be provided, was won in the face of keen continental competition.

A delegation of technicians from Huta Lenina, the largest and most modern steelworks in Poland, spent some time at The Steel Co. of Wales' works where similar Head Wrightson equipment is in operation.

The equipment has provision for automatic feeding, final inspection, sorting and packing. In addition, the company are providing the engineering details for the auxiliary plant that includes palm oil storage and preparation tanks, acid tanks, cooling and cleaning air blowers, fans, ducting and fume exhaust systems. The two lines will give an estimated output of 10,000 tons per year.

MODEL OF AUTOMATIC RHODIUM PLATING PLANT

AT the Mond Nickel Co's exhibition staged at the Cutler's Hall, Sheffield from June 2-5, one of the most interesting features was a working model of a rhodium plating plant. The model is claimed to be the first automatic rhodium plating plant ever built and it was specially designed for the exhibition.

The plant, one of the latest demonstrations developed by the Company, had a capacity of 240 items an hour and, handling 8 items at a time, completed the plating operation in two minutes.

One of the platinum group of metals, rhodium is refined by the Inco-Mond Organization, responsible for nearly half the free world's platinum metals in addition to being the world's largest nickel producers.

The exhibition, at which the new automatic plating operation was featured has been designed to demonstrate the properties of nickel, nickel-containing materials, the platinum metals and spheroidal graphite cast iron to engineers, technologists and students.

H.V.W.M. Down Under

IT was announced recently that Glen Walker and Co. Pty. Ltd., Melbourne, Australia, who have been appointed agents in that country for the Hanson-Van Winkle-Munning Co., have commenced the Australian production of addition agents under the names of Nickel-Lume, Levelume, and H.V.W.M. bright cyanide copper.

A.S.T.M. changes stainless steel specns.

THE American Society for Testing Materials has reported that specifications A 296-55 and A 297-55 covering grades of corrosion-resistant and heat-resistant ferritic and austenitic stainless steel castings are being subjected to some extremely important changes. The alterations do not appear in Part 1 of the 1958 *Book of ASTM Standards* but an outlined version for the convenience of producers and purchasers of stainless steel castings can be obtained from the A.S.T.M. at 1916 Race Street, Philadelphia 3, Pa., U.S.A.

Elga's New Chiltern Factory

A NEW factory at Lane End, Bucks, has been taken over by the Ion Exchange Division of Elga Products Ltd., to house the headquarters, research, and service regeneration departments.

The area covers three-quarters of an acre, thought to be by far the largest production unit in Europe specializing in the design and manufacture of deionisation equipment for academic and industrial research.

Lane End is a typical Chiltern village, unusual perhaps as an industrial setting, but chosen the company says because ideal working conditions and congenial surroundings are important to the class of product made.

The ion exchange process for producing pure water has rapidly gained in popularity during the last four years. The Pharmacopoeia Commission changed the BP specification in 1955 to allow deionised water to be substituted for distilled water, and this has undoubtedly accelerated use of the product.

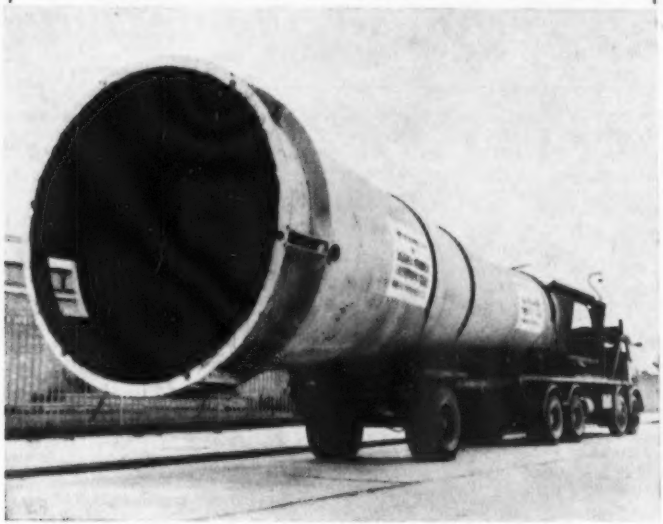
OBITUARY

Evans : It is with regret that we have to record the death on May 24 of Mr. Percy Evans, aged 73 years.

For over half a century Percy Evans was very actively engaged in the paint industry with Pinchin, Johnson and Co., where he rose from office boy to become sales manager and joint general manager. On his retirement in 1951 he was appointed to the board as director until 1956 when he retired from active duty.

He was well known throughout the paint industry and in industry generally where his activities brought him into close contact with leading personalities, all of whom will learn with regret of his death.

Billingham Stack is Rubber Lined



THE section of fume stack seen in the picture above has been erected at I.C.I.'s Billingham plant. Sixty-four feet long, it has been lined with rubber by the Dexine Rubber Co., Rochdale, a member of the plant lining group of the Federation of British Rubber and Allied Manufacturers. Used for carrying away dust and vapours from I.C.I.'s new "Kaynitro" plant, the $\frac{3}{16}$-in thick lining will give protection against corrosion by chlorides and sulphates at temperatures up to about 60° C. The completed stack of seven sections will eventually be about 250 ft. high.

Also lined in rubber are the plant's spray towers for dedusting gases.

STELVETITE IN NEW FILM

THE story of "Stelvetite," the plastic-coated steel sheet produced by John Summers and Sons Ltd., Shotton, Chester, has been chosen by the Rank Organisation for one of the first of a new weekly series of magazine films in colour. The new series, called "Look at Life" has just been introduced to replace the black and white newsreels of the Rank Organisation shown at Odeon, Gaumont and many independent cinemas.

The Stelvetite story, No. 4 in the series, occupies the whole of one of the ten minute reels, and it contains some of the most outstanding colour shots ever filmed in a large steel works. The manufacture of the P.V.C. plastic at the Manningtree factory of B.X. Plastics Ltd., the making of the steel sheet at Summers' works at Shotton, and the subsequent production of the Stelvetite are all shown. Title of the film is "A Marriage is Arranged." It ends with scenes showing how this new material is already being used for a wide variety of domestic articles and telling of its future possibilities. The film was on general release at the beginning of this month.

Cannings Present Cleaning Plant

A PLATING plant for research purposes has been presented by W. Canning and Co. Ltd. to the Coil Spring Federation Research Organisation. The new laboratories of the organisation, opened in July, were described by Mr. R. Salter Bache, president of the organisation, as being amongst the most comprehensive of their kind in the world.

The plating plant is to be used in conjunction with work on spring steels primarily with a view to minimising hydrogen embrittlement on high tensile steels.

The actual equipment consists of a line of cleaning and plating tanks complete with a 100 A. 6 V. rectifier and other ancilliary apparatus.

The processes will be zinc, cadmium, copper, nickel and acid tin in all of which Canning materials will be used. In addition, the cleaning line will comprise an anodic hot electrolytic cleaner, together with an acid cleaning tank.

In presenting this plating section of the laboratory, W. Canning and Co. Ltd. accepted honorary membership of the research organisation. It is hoped that the work carried out will be of great benefit to both.

Cannings extend Australian interests

THE Australian interests of W. Canning and Co. Ltd., Great Hampton Street, Birmingham 18, have been extended by acquiring a holding in Lawrence Smith and Co. (Pty) Ltd., Sydney, with whom they have been closely associated for more than 50 years.

Name of the Australian company is to be changed to Lawrence Smith and Canning (Pty) Ltd., with head office and warehouses in Sydney and a branch office in Melbourne.

Cyclone fan makers move B'gham address

MANUFACTURERS of Cyclone fans and equipment Matthews and Yates Ltd., announce that they have transferred their Birmingham office to larger premises at Smithfield House, Digbeth, Birmingham 5. Telephone : Midland 7284 (2 lines).

Cambridge Instr. Move

WITH the acquisition of the lease of No. 14 Grosvenor Place, the Cambridge Instrument Co's headquarters have been extended to permit enlarged sales facilities and better attention to customers and correspondents. The official address will remain 13 Grosvenor Place.

The publicity and accounts departments, which in recent months have had separate premises, have moved back to headquarters, and the premises at 60 Buckingham Palace Road have now been vacated.

Borax price up

AS a result of increased raw material and manufacturing costs, the price of borax and boric acid products rose on August 17 by £1 and 30s. per ton respectively.

Trade and Technical Publications

In the April issue of The Nickel Bulletin, attention is directed to literature on deposition of nickel from sulphamate solutions, methods of evaluating porosity in electrodeposits, and the effect of nickel plating on adherence of vitreous enamel. Items on properties and uses of non-ferrous alloys are followed by sections on nickel-iron alloys and nickel-containing cast irons. The literature on heat- and corrosion-resisting materials includes abstracts dealing with such subjects as properties of relevant nickel-containing alloys and steels, development of new materials, intercrystalline corrosion, corrosion testing, resistance to specific corrosive media, and brazing and welding.

The issue also contains the quarterly review of recent patent literature. The review comprises more than fifty abstracts, ranging in subject matter from nickel catalysts to thermionic cathodes, brazing alloys, improved corrosion- and heat-resisting materials and electrolytic and electroless methods of nickel plating. The publication is available from The Mond Nickel Co. Ltd., Thames House, Millbank, London, S.W.1.

* * *

"Electrified production" is a news sheet issued by the Electrical Development Association, 2 Savoy Hill, London, W.C.2, to provide electrical news for industry. One item in No. 2, the latest issue, describes electric heating of plating vats at a firm of jobbing platers, Tucker's Radiator Services Ltd., Redcliffe Hill, Bristol 1. The firm sought the advice of the South Western Electricity Board on the electrification of a gas-heated vat, and the outcome was the installation of immersion heaters in a nickel-plating vat. The account goes on to say that the successful result led the firm to electrify the heating of their bright chrome-plating bath, and subsequently two hard chrome vats (used for plating special printing rollers), and a further nickel vat.

* * *

A recent issue of "Roto-Finish record" includes an article on the company's machines and processes suitable for the smaller firm; applications of their processes; a description of "Grisiron" at work; and an account of the MEPP electro-polishing processes for industry.

The example of the smaller firm using Roto-Finish products is Morgan and Brace Ltd., a firm of precision engineers near Aberdare, employing about 50 skilled machinists on sub-contracted work for a number of aircraft and instrument manufacturers. Using a Roto-Finish DW 16-16-2 double compartment machine, operated by a single part-time employee, the account says that hand deburring has virtually been eliminated except for a very few items too large to be accommodated. Since a single operation is sufficient for the purpose, only a limited variety of barrelling media is required, and in fact only four sizes of grinding chip and three compounds are used. The publication is available from Roto-Finish Ltd., Hemel Hempstead, Herts.

* * *

"A guide to services available from the Metal Finishing Division of Pyrene" is a well-produced and illustrated brochure describing the comprehensive facilities available to users of the "Bonderizing," "Parkerizing," "Pyluminizing," "Parco-Lubrizing" and other Pyrene pre-treatment processes. A map is included at the end of the brochure showing the location of plants throughout the U.K. where processing facilities are available to customers not having sufficient production to warrant the installation of their own plant. The Finishing Division of Pyrene Co. Ltd. is at Great West Road, Brentford, Mddx.

* * *

"Positive rust proofing" has been published by the Metalife Group of Cos., Station Square, Harrogate, Yorks., to describe their liquid metal products, applied cold to iron and steel by brushing, spraying or dipping. Applied in this way, the preparation deposits an anodic coating on the cathodic base metal, and, because of the difference between the electro-potential of the two, a degree of cathodic protection is obtained. If the system is intended to withstand strong acid or alkali conditions, then a sealer is used over the "Metalife" coating. Two of these sealing finishes are available from the company; "Metalkote" for alkalis and solvents, and "Kemikote" for acids.

* * *

Two leaflets, "Melanoid bituminous paint" and "Ferrodor metal protective paint," have been issued by Griffiths Bros. and Co. London Ltd., Armour Works, Well Lane, Wednesfield, Staffs. "Melanoid" is described as a high-grade utility paint designed to give at low cost protection against corrosive atmospheres and influences. The "Ferrodor" metal protection system is based on a comprehensive range of rust inhibitive primers for specific conditions, protected by a paint film. Both primer and finish are based on micaceous iron oxide, and are available in a range of metallic shades. The system is well tried, and has, in fact, been used for more than half a century. A typical installation on which it has been used is the Sydney Harbour Bridge.

* * *

A "Buffing cost analysis" form is available from the Schaffner Mfg. Co. Inc., Schaffner Center, Pittsburgh 2, Pa. By following the programme outlined in the form, the company says that the compound cost per unit, buff cost per unit, and the hourly or daily compound of buff usages can all be ascertained. A method of evaluating various products in this field is also described.

* * *

Engineering data sheet ZMP-558 from Barlow-Whitney Ltd., 2 Dorset Square, London, N.W.1, describes the company's white metal pots for zinc, lead, and tin, etc. The pots are designed to operate at temperatures up to 600°C. and can be used for such purposes as dip galvanizing and tinning. A separate heat regulator, fitted with a pilot light, can be supplied for adjusting the input and thus the temperature.

* * *

The first issue of "Alloys and Metals Review," published by Union Carbide Ltd., 103 Mount Street, London, W.1, appeared during May. The review is to be published on a regular basis, and No. 1 contains articles of interest to metallurgists and others employed in foundry work. An item of interest to metal finishers is a description of various modern processes in casting stainless steel, compiled with assistance from Firth-Vickers Stainless Steels Ltd.

* * *

A recent issue of "Tin and its uses," published by the Tin Research Institute, Fraser Road, Perivale, Greenford, Mddx., contains a comprehensive survey of the canned foods industries comprising the papers read at the Third World Congress on canned foods held at Rome in 1956. Further information on soldering is contained in a new book reviewed in the issue, dealing with the reliability of electrical (soldered) connections, and a new soldering flux medium is suggested.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

Simple Paint Spray Outfit

THE "Tuffy" paint spraying outfit, illustrated in Fig. 1, that has just been introduced by the Aerograph-DeVilbiss Co. Ltd., 47, Holborn Viaduct, London, E.C.1, is designed for small-scale industrial or decorative work. The outfit consists of an electrically-driven diaphragm-type compressor that weighs 34 lb. and can be plugged into an ordinary lamp fitting, 12 ft. of air hose, and a CGA cup feed spray gun with a one-quart capacity. As a diaphragm-type compressor is used, there are no exposed belts, pulleys or fly-wheels, no oiling is required and there are no valves. It has a capacity of 2 cu. ft. per min. of air delivered and there is a built in air pressure control and safety valve. The spray gun is fitted with a fluid needle adjusting screw that controls the maximum volume of paint that will pass through the gun and is also a useful form of adjustment for misting, shading and similar jobs. Typical applications for the outfit include car repair and refinishing, furniture renovation and indoor and outdoor housepainting.

Fig. 1.—Designed for small scale industrial or decorative work, this electrically driven compressor can be plugged into a lamp fitting.

Additives for Chromium Plating

A NEW combination of stable, surface-active additives for all types of chromium plating baths, including those using catalysts other than sulphate, Zero-Mist HT-2 has been introduced by the Electro-Chemical Engineering Co. Ltd., Sheerwater, Woking, Surrey. It is supplied in tablet form in two colours, *green* for initial addition in the ratio 6 lb. per 1,000 gal., and *off-white* for maintenance additions. It is claimed to produce a thin film of foam on an operating chromium bath that eliminates mist and spray regardless of the type and operating temperature of the baths, and to reduce dragout losses. The use of Zero-Mist eliminates fans and ducting normally required for the extraction of fumes, minimises chromium staining on plated components, and is not destroyed by the most concentrated boiling chromic acid solution nor affected by the highest anode or cathode current densities, the makers say.

In practice, the only requirement for the suppression of mist and spray is to have a sufficient concentration of Zero-Mist HT-2 present in the chromium plating solution to maintain a thin film of foam during plating. The film must be maintained by adding tablets as required. If desired, the surface tension of the solution (an indication of the concentration of additive in the solution) can be determined by a simple stalagmometer method.

The quantity of maintenance tablets used will naturally vary from one installation to another depending on the amount of dragout, but is expected to be about 8 oz./1,000 gal./week for an average installation. It should be noted that frequent small additions are preferable to larger ones at greater time intervals, and if a satisfactory thin film of foam is present just before the tank is shut down, it is not necessary to make any addition when starting up again, regardless of the time interval.

Automatic Metal Pre-Treatment Plant

THE "Agi-Dip" fully automatic multi-stage pre-treatment plant (Fig. 2) recently introduced by the Electro-Chemical Engineering Co. Ltd., Woking, Surrey, can be used for various types of cleaning and process treatments, including pickling and phosphating, on a wide variety of ferrous and non-ferrous metal components. Parts to be treated are loaded into baskets, then automatically passed through agitated immersion stages,

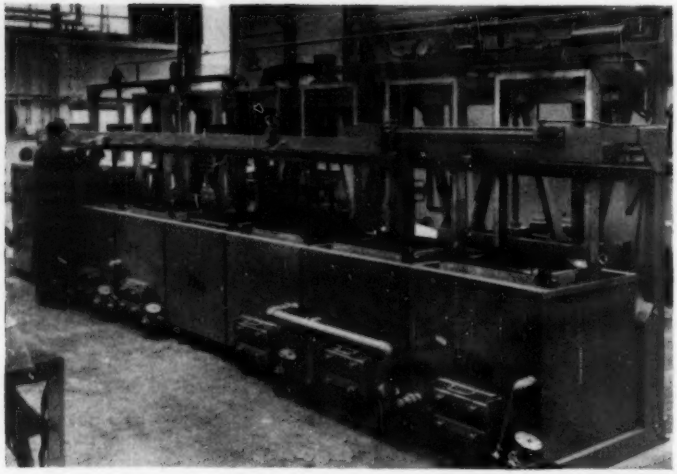
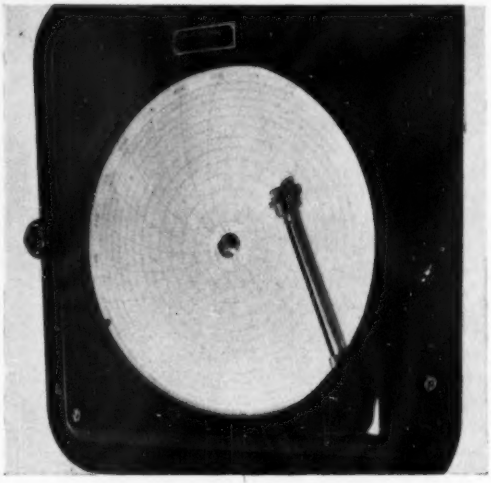


Fig. 2.—A fully automatic multi-stage pre-treatment plant that can be used on a wide variety of ferrous and non-ferrous metal components.

Fig. 3.—Available as a single or four point temperature recorder, the instrument shown below makes use of transistors to improve performance.



depending on the treatment required. Trichlorethylene vapour degreasing, spray rinsing and drying sections can be incorporated into the sequence if required.

Agitation is made by a reciprocating pneumatic arrangement adjustable for amplitude and frequency of stroke. Double-acting air cylinders enable the work platforms to be driven down into the solutions at a faster rate than the freely falling components, thus effecting complete separation of tightly packed parts. The work is transported through the sequence by an index beam conveyor controlled by a timing mechanism that can also operate automatic loading and unloading platforms to link the plant with a shop conveyor. Only one operator is normally required for the plant.

"Four Point" Temperature Recorder

AFTER field trials on the plant of some of Britain's largest instrument users, Fielden Electronics Ltd., Wythenshawe, Manchester, Lancs. have recently introduced their new transistorised "Four Point" temperature recorder. This has a 10-in. dia. chart and operates from the normal 50 cycles mains supply. Resistance bulbs are used as the temperature sensitive elements and low range spans are easily achieved, the makers say. The recorder is illustrated in Fig. 3.

It is claimed that the use of transistors has significantly reduced the power dissipated in the instrument and has resulted in improved performance and greater realiability. Particular features are the new improved stability control and the very high reproducibility. The instrument is also available as a "Single Point" recorder with electrical or pneumatic control.

Protective Primer for Shot-blasted Surfaces

A PRIMER for the protection of shot blasted steel surfaces prior to the application of the final paint scheme has recently been introduced by Robert Bowran and Co. Ltd., Pelaw, Gateshead 10, Co. Durham. Called "Vedette," the company says it has undergone extensive trials in British shipyards where the material has been used as a primer on shot-blasted steel plates treated before fabrication.

The primer has been formulated for spray application, though touching-up can be done by brush, and the coverage on average can be taken as 1,000 sq. ft. per Imp. gal. At this rate, the company says, a film thickness of approximately 0.5 mils. is obtained. Drying time is said to be

between 2 and 4 min., so that the spraying of plate can be undertaken as part of the process of automatic shot blasting plant where the flow of treated plates is moving at the rate of, say, six ft. per min.

Advantages claimed for the material are: it gives 6-12 months weather resistance, provides galvanic protection where the film is broken by scratches, etc., resists immersion in water and oil, is non-poisonous for drinking water spaces, is compatible with any subsequent cathodic protection system, and if required can be removed by naptha or xylol. The company also claim X-ray photographs show that "Vedette" enhances weldability of the plate. Supplied ready for use in a spraying consistency, the primer is available in grey only.

Gas-fired Trolley Loading Ovens

A NEW comprehensive range of "B-W" gas-fired forced-convection trolley loading industrial ovens with a choice of direct or indirect heating, and incorporating the latest safety features recommended by the Gas Council and H.M. factories inspectorate, has been introduced by Barlow-Whitney Ltd., London and Bletchley (Fig. 4).

The ovens are primarily intended for the larger and heavier charge that can be more conveniently handled on mobile platforms or stillages. They can also be supplied with suspension bars, or racks for tray loading or other special arrangements to requirements, and are suitable for many process-heating applications, including baking, curing, pre-heating, polymerising and stoving. There are two standard versions—series GD/TLO 300 ovens for temperatures to 300°C., direct-fired units in which the products of combustion pass through the working space, and series GIN/TLO 250 indirect-fired types for temperatures to 250°C. which are so arranged that the products of combustion are excluded from the working space. Size in both styles range from about 100 to 2000 cu. ft. and all models include fully automatic temperature control, flame failure equipment and explosion relief panels. Doors can be of the vertical counter-balanced type or hinged pattern as preferred.

Drum-lifting Device

A MODIFIED version of the VLL/10 drum lifting device that incorporates a "pre-loading" safety mechanism has been introduced by British Electrical Repairs Ltd., Manchester. The new model can be supplied to handle drums of any type, size or weight.

The safety mechanism ensures that adequate clamping pressure is exerted before the drum leaves the floor, eliminating the danger of load-slip and allowing the device to be used for "snatch" lifting.

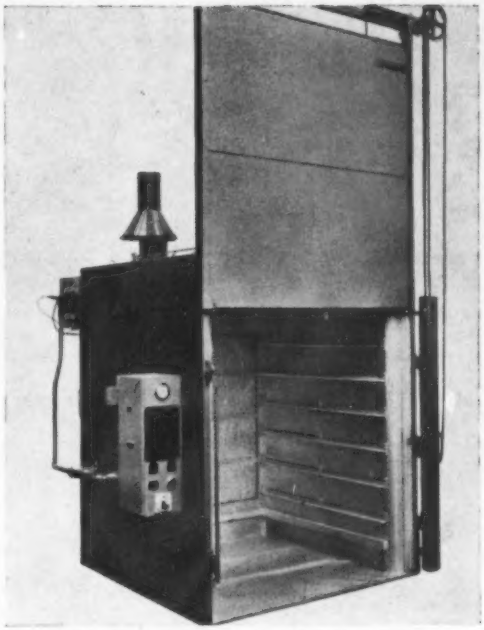


Fig. 4—Gas-fired trolley loading oven.

Briefly, the device works as follows: whilst suspended from a crane or hoist hook prior to lifting, the clamps remain in the "locked open" position, but when the device has been lowered on to the drum end, the movement of a hand lever through 190 deg. sets the clamps in the "pre-loading" position. As the drum is lifted, clamping pressure is further increased by the supporting lever linkage mechanism. Steel backed bronze bearings are incorporated and these are arranged for grease gun lubrication. A power-operated model is available equipped with fully automatic or remote electrical control that can be operated by the driver of a mobile crane, for example.

When fitted with large arc clamps, the VLL/10 can be used for handling open-top steel or cardboard drums. The company have also developed a range of manual and power operated devices for lifting and rotating drums through 360 deg.

Inter-Process Metal Washing Machine

THE machine illustrated in Fig. 5 is an inter-process unit for removing oil and swarf from gear blanks prior to gear cutting. As the blanks are removed from the automatic lathes they are

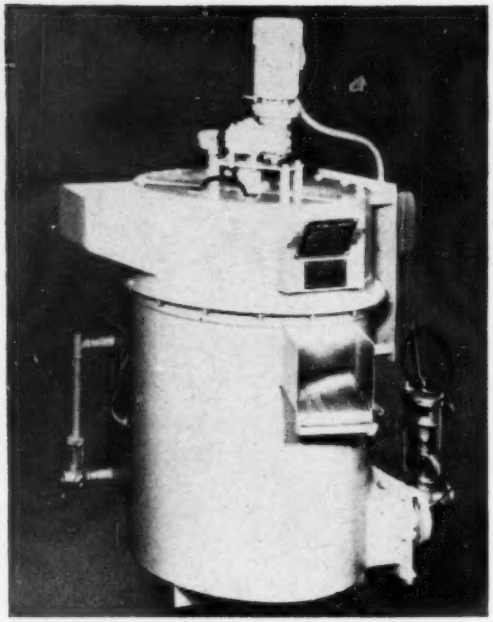


Fig. 5.—Using a hot detergent solution, this inter-process unit has been adapted to wash gear blanks prior to tooth cutting.

immediately placed in the machine sited alongside. Inside the machine is a flat perforated plate around which the blanks are swept from the loading point by a four-arm sweep continuously revolving at approximately one r.p.m. The blanks are continuously sprayed with a hot detergent solution, and are then automatically discharged down a shute to the waiting collection box or tray.

The machine is completely self-contained, and it is a relatively simple matter to disconnect the services and move the machine to another part of the works. A useful fact is that it is arranged for three point mounting and can, within limits, be placed on any floor without the floor being levelled or without special foundation preparations being made.

This extremely useful little machine should be of interest to all manufacturers of similar parts where inter-process cleaning is required. It is manufactured by Dawson Bros. Ltd., Gomersal, Nr. Leeds and the sole agents are Drummond-Asquith (Sales) Ltd., Birmingham.

Pressure Containers for Liquid Polishing Compounds

TWO new centre-top outlet pressure containers, specially designed for use with liquid polishing compounds and similar heavy materials have been introduced by Alfred Bullows and Sons Ltd., Long Street, Walsall, Staffs. The containers replace the conventional bottom outlet types and have capacities of 5 and 10 gal. respectively. The illustration, Fig. 6, shows one of the containers.

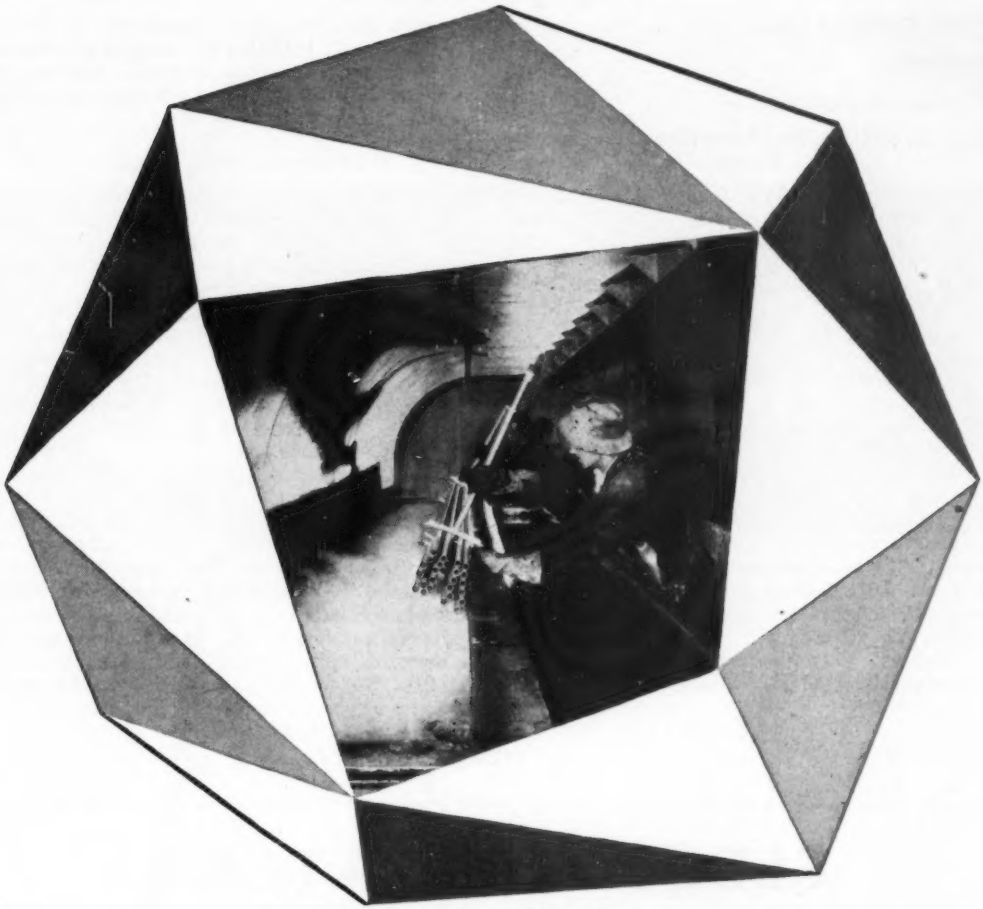
Fig. 6—.Designed for use with liquid polishing compounds, the pressure container shown below has a centre-top outlet.

Shells are constructed from mild steel boiler-quality plate with dished and flanged ends and are electrically welded throughout. Covers are high tensile aluminium alloy castings and are fitted with quick action filler caps. The containers are built to B.S.S. 1101/1943 for a maximum working pressure of 50 lb. per sq. in. and are hydraulically tested to 100 lb. per sq. in.

Ram plates are fitted on both models as standard equipment. Agitator gear has been omitted since it is usually undesirable to stir the types of materials for which these containers would be used. Both units incorporate $\frac{3}{4}$-in. O.D. straight-through feed pipes, which have no bends or obstructions to impair the flow of material, and discharge is from the centre of the container head. An outlet of $1\frac{1}{4}$-in. dia. is available as an alternative.

The makers say that outlet valves are not considered necessary when liquid polishing compounds are used, but if required for use with less viscous materials, these are available at extra cost.

(*Continued in page* 30)



The largest PHOSBRITE *plant in Britain*

Installed at the Birmingham plant of Haynes, Ford & Elliott Ltd is the largest Phosbrite plant in Britain. The 600 gallon tank is particularly interesting not only for its size but also because of the variety of items being chemically polished – from wheel discs to curtain rails – from wash boiler tubs to decorative light fittings. This plant proves without doubt that *CHEMICAL POLISHING WITH PHOSBRITE SOLUTIONS SAVES TIME & MONEY.* Phosbrite 159 for Aluminium and its Alloys. Phosbrite 183 & 184 for Copper and its Alloys Phosbrite 501 for electrolytic polishing of Stainless Steel and Alloys.

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Metal Finishing Department
ALBRIGHT & WILSON (MFG) LTD
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Albright & Wilson (Mfg) Ltd also supply Plusbrite addition agents for bright nickel plating, together with chemicals for special processes in tin, copper and nickel plating and electrolytic polishing of ferrous metals. VAW/693

Plant, Processes and Equipment

(*Continued from page 298*)

I.C.I. Paints Division Introduces New Stoving Finish

A NEW one-coat paint finish for domestic equipment—" Dulux " acrylic stoving enamel F 664-line—has been introduced by I.C.I. Paints Division. The material is particularly suitable for refrigerators, washing machines and other metal equipment used in kitchens and bathrooms, say the makers, who claim a number of advantages over the usual two-coat system of primer and finish.

In appearance and other properties " Dulux " acrylic stoving enamel is mid-way between vitreous enamel and an ordinary paint finish. It is claimed that there are applications where it can be considered as an alternative to vitreous enamel and satisfactory tests have already been carried out on washing machine tops. No primer coat is normally necessary and a stoving operation is thus saved. In a one-coat system with a film thickness of about 0.00175-in. it will give a superior performance to that of any established two-coat system, the makers say.

" Dulux " F 664-line can be used on steel, electrolytically zinc-coated steel, and aluminium, provided these are suitably pretreated. A chemically clean and corrosion-free surface is essential before painting. Dipping or stoving primers can be supplied where necessary for covering surface imperfections.

Polyester Film Tapes

A NEWLY formed subsidiary of Johnson and Johnson (Gt. Britain) Ltd., Permacel Tapes Ltd., 260, Bath Road, Slough, Bucks, announce the addition of two new products to their range of pressure sensitive tapes.

These are Permacel 62 (transparent) and 621 (orange) " Melinex " thermosetting electrical tapes. The high heat stability provided by the backing, combined with the type of adhesive used, makes these tapes suitable for use where continuous high operating temperatures of up to 150°C. are encountered, the makers say.

Both tapes are manufactured from 100 gauge " Melinex " Polyester Film spread with an electrical grade thermosetting adhesive which, in its uncured state, has excellent pressure sensitive characteristics. After cure at a given cycle, the tape becomes bonded to the surface to which it has been applied, rendering it resistant to attacks of paint and varnish solvents and most transformer oils. A waterproof backing resistant to acids, chemicals and alkalis broadens the field of application to other industrial users.

the lowest priced bright nickel plating process but –

it provides

* High ductility
* Excellent levelling
* Low internal stress
* Good receptivity to chromium plate
* Good colour

Plusbrite additive agents are not removed by continuous filtration, and they are easily controlled.

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SUPERINTENDENT REQUIRED for Vitreous Enamelling Department in a Foundry in Falkirk. Must have wide knowledge of modern practice. Only energetic persons keen on development work and in receipt of a four-figure salary need apply. Pension and Life Insurance Schemes. Reply, giving full details, to Box 217, METAL FINISHING JOURNAL.

FIRST CLASS PLATING TECHNICIAN required to control bright nickel, copper and chrome solutions. Must have had laboratory training and practical experience. Laboratory and chemist available for the analysis of all solutions. Good wages and bonus for suitable applicant. C. E. Marshall (Wolverhampton) Ltd., Macrome Road, Green Lane, Tettenhall, Wolverhampton.

NOTICE

North Staffordshire Technical College, Stoke-on-Trent

COLLEGE OF CERAMICS

Courses in Vitreous Enamelling

SESSION 1959-60

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Part-time Course in Vitreous Enamelling

This is a less comprehensive course of three years' duration in VITREOUS ENAMELLING and METALLURGY, intended for those who can only be released from work on two half days each week.

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Further details of the courses can be obtained from Head of Department.

PATENT

PATENT No. 790,008 "Coating light metals" for sale or licence. Apply: Chatwin & Company, Chartered Patent Agents, 253, Gray's Inn Road, London, W.C.1.

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